PRINCIPLES AND PRACTICE

OF

CROWN AND BRIDGEWORK

HART J. GOSLEE

PRINCIPLES AND PRACTICE OF CROWN AND BRIDGEWORK

A treatise upon the modern methods of restoring natural teeth, and of replacing missing teeth by means of artificial crown and bridgework.

BY

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FOREWORD

The wonderful advancements made in all branches of dentistry, and the splendid improvements made in the specialty of crown and bridgework, in particular, during the past few years, have seemed to demand an entirely new book to replace the few previous editions, and to justify the effort connected therewith.

This work is offered to the teachers, practitioners and students of dentistry without apologies, but with the belief that it may be useful as a modern and practical text and reference book.

The work was a work of love, and was inspired by the continued encouragement of many friends and associates. To all of them assurances of deeply-felt gratitude, and of profound affection are expressed.

HART J. GOSLEE.

Chicago, October Twenty-Third,
Nineteen Twenty Three.

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PRINCIPLES AND PRACTICE OF CROWN AND BRIDGEWORK.

CHAPTER I.

HISTORY.

History records that the crowns of natural teeth were restored and missing teeth were replaced before the Christian era. Specimens of bands, of crowns, and of dental bridgework made by the Etruscans have been found and are preserved in the National Museum of Italy, in Naples, and in the Lombros collection at Athens.

Writing in the fifth century B.C., Herodotus and Hippocrates refer to dental operations. Aristotle, also, wrote on the subject about 350 B.C.; Horace, 65 to 8 B.C.; Ovid, 43 B.C. to 17 or 18 A.D., and Martial, who lived in Rome, and whose writings cover the period from 43 B.C. to 104 A.D., was a satirist, as well as a poet, and in one of his poems runs this couplet:

> "False teeth and hair flaunts Laelia shamelessly,
> But not false eyes, for these she cannot buy."

From these writings it is evident that artificial teeth were made and used in Rome at that time. Other Latin and Greek poets, including Cicero, refer to them, and in the tenth century A.D., Abulcasis describes the operation through which artificial crowns were attached to adjacent natural teeth.

These historical facts would indicate that the ancients of the classic period were proud of their teeth, and that efforts toward restoration and replacement were made.

It is the general belief that the Romans acquired their knowledge of dental restorations from the Etruscans, and the Etruscans and Greeks, in turn, from the Egyptians.

This belief is based on the fact that specimens of dental work have been found in the jaws of mummies buried probably 500 or 600 years before the Christian era.

Artificial teeth made of ivory, bone, wood, or stone and attached to the natural teeth by means of cord, or gold, or silver bands, or ligatures, were the progenitors of modern artificial crowns. And natural teeth, bound together with gold bands, pioneered the way to modern bridgework.

Fig. 1.

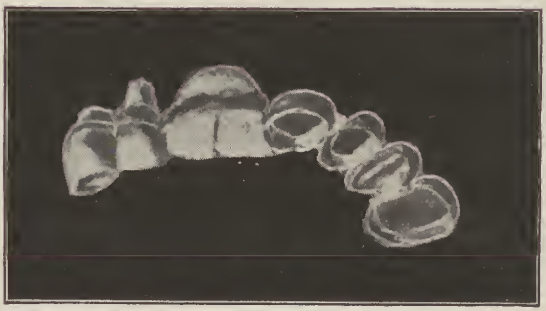


Fig. 2.

In so far as is known, no authentic specimens of fillings of equal antiquity have been discovered. Gold fillings believed to have been found in the teeth of Egyptian mummies, upon investigation, proved to be merely superficial applications of gold made for ornamental purposes.

The Etruscan craftsmen, particularly, were familiar with a variety of the requirements of bridgework, and it is recorded that the Romans constructed both fixed and removable appliances. Among the relics found at Tanagra, which date from probably 600 B.C., and which are now preserved in the Lombros Collection at Athens, is one which points clearly to an effort to stabilize loose teeth by means of an assemblage of bands made of soft gold (Fig. 1), and another which shows an effort toward the replacement of missing teeth (Fig. 2).

Whether dentistry became a lost art in the middle ages is not known. Dental literature at the beginning of the eighteenth century records the application of "pivot" teeth to roots, but the beginning of the resurrection of ancient methods was not marked until the early part of the nineteenth century, and the first evidences of the revival doubtless came from the French.

Advent of Porcelain.

In the remote ages human teeth, the teeth of cattle and sheep, hippopotamus tusks, elephant and other ivories and bone were used for crown and bridgework restorations, but in 1728 Fauchard, a French dentist, proposed the use of porcelain. The actual manufacture of "mineral" teeth, however, did not begin until some time between 1774 and 1776

Fig. 3.

Fig. 4.

when Duchateau, a French chemist, assisted by Dubois, a dentist of Paris, introduced porcelain teeth.

The practical introduction of artificial restorations for the natural crowns of teeth lost through accident, or caries, and the ultimate development of the specialty of crowu and bridgework are products of the last half of the nineteenth century. This development is due to the progressive efforts of American dentists, and to the application of the principles of American dentistry.

Crown and bridgework has grown into an important specialty hand in hand with the growth of the profession as a scientific vocation, and even though no standardization of methods has been possible, the evolution of this specialty provides material for an interesting chapter in the history of dental art.

New fields for higher esthetic conceptions have been opened through this specialty, and the general advancement of the profession has been promoted, for, at one time, it seemed that dentistry must be divided into two separate branches—operative and prosthetic. It was believed for a time that the average practitioner, who could or would become proficient in both branches, would be the exception rather than the rule.

However, crown and bridgework, dividing the work of mind and hand, chair and laboratory, equally, reunited the two branches.

Much of the advancement which the profession has made since then must, therefore, be placed to the credit of this specialty, and no field in art or mechanics offers greater opportunity for the display of artistic attainments and skilful craftsmanship. And the possession and development of these talents draws a fine line of distinction between the artisan and the true artist.

Primitive Applications of Artificial Crowns.

From available records, the first application of "pivot" teeth is described by Fauchard, 1728, in which description a crown, fastened to a root with a "pivot," is mentioned. If a natural tooth was not available, the artificial

Fig. 5.

crown was carved out of bone or ivory, and was mounted upon the root with a roughened pivot of silver or gold. (Fig. 3.) The interior of the root was first filled with lead, into the center of which a hole for the reception of the pivot was drilled, the other end of the pivot having been cemented into a hole in the crown previously.

In 1816 de Chemant makes many references to the use of "mineral" paste and a brief description of a "single tooth with pivot" is given. The description is accompanied by a crude illustration which indicates it was intended to be attached to a root. (Fig. 4.)

Other designs of "mineral" teeth are recorded in subsequent French literature, but it was not until about 1840 that much effort was made toward, or much thought given to, the problem of restoring lost crowns of teeth. It is evident that the prevailing and common practice then was to extract them and insert dentures, or, in some instances, to grind them down even with the gingival tissues and retain them for the purpose of preventing absorption.

About this same time more progressive and esthetic ideas were conceived, and the English tube-teeth, designed and used previously for metal dentures, were introduced and adapted to the restoration of the natural

crowns of teeth. (Fig. 5.) Originally they were ground to fit the supporting root and mounted with pivots of hickory wood.

This practice was a revelation, and marked the advent of modern crown work. The wooden pivot, however, was impracticable, because the expansion often caused a fractured root, while the presence of moisture, which was necessary to expansion, invited caries.

Dodge Crown.

Modifications of this method became necessary, and followed promptly. In 1844 a porcelain crown and a method of attaching it to the supporting root were patented by Dr. J. S. Dodge. This patent involved a wooden tube mounted in the root, and a porcelain crown having a pivot of gold or silver. The pivot engaged closely into the cylinder of wood by which

Fig. 6.

means the crown was attached, and removal made possible. As a means of permitting subsequent treatment, which frequently became necessary because of failure to obtain asepsis primarily, removal and replacement were demanded.

In 1849 a crown was patented by Dr. F. H. Clark. This patent was simply for an improvement upon the Dodge crown, and involved the insertion of a metal tube in the root, instead of one made of wood. The crown was then anchored to the root by means of a "screw-pivot" having a large head and perforated through the center to allow "accumulated gases" to escape.

Foster Crown.

In 1855 a crown known as the Foster crown was patented. This crown had a base, almost flat, with a perforation in the body of the porcelain. The perforation was so shaped as to form a seat for the accommodation of the enlarged head of a screw-pivot by which means it was anchored to the root. (Fig. 6.)

Mack Crown.

In the preceding types the dowel was attached first to the crown, and then to the root. In 1872, however, a deviation was made, and a patent

was issued to Dr. C. H. Mack, covering an artificial crown in which the dowel was attached firmly to the root before the crown was mounted. The crown was made with a countersunk cavity in the body of the porcelain, and was attached by filling this cavity with a plastic substance. (Fig. 7.)

The Gold Telescope Crown.

The possibility of restoring the crowns of posterior teeth by means of all gold crowns was probably conceived and suggested first by Dr. W. N. Morrison, but that type of artificial crown restoration which is now known as the gold telescope crown was patented in 1873 by Dr. J. B. Beers.

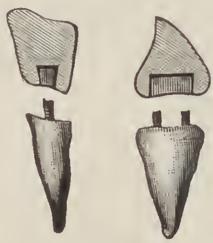


Fig. 7.

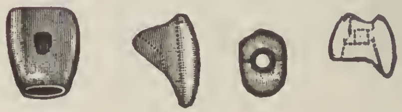


Fig. 8.

The difficulty incident to adapting dowel crowns to posterior teeth led to the invention and application of the gold telescope crown. The application of a hollow telescoping restoration permitted the conservation of tooth structure, and made possible a useful and serviceable reproduction of the natural tooth crown. For the first time, the line of junction between crown and root was carried under or within the free gingival margin.

The success of this type of crown for the posterior teeth has resulted in the invention of many systems and methods of construction, all of which, while varying in detail, accomplish practically the same end.

Gates-Bonwill Crown.

As a result of the successful application of the Foster and Mack crowns, an improvement appeared later and became known as the Gates-Bonwill crown. A patent was issued to Dr. W. H. Gates in 1875, and one to Dr. W. G. A. Bonwill in 1881, covering practically the same ideas.

This crown was made of porcelain and was constructed with a concave, instead of a flat base, and with a triangular perforation through the body of the porcelain. (Fig. 8.) The formation of the perforation afforded

a secure means of attachment to the supporting root. A metal dowel was threaded and screwed into the canal first, and the crown was then attached with amalgam.

Howland-Perry Crown.

Shortly afterward the Howland crown, subsequently modified by Dr. S. G. Perry, and designated as the Howland-Perry crown, was suggested, and manufactured. This crown was similar to the preceding types, but, like the Mack crown, differed in that the accommodation for the dowel was confined to a cavity in the body of the porcelain, instead of passing entirely through it. (Fig. 9.) The preservation of the continuity of the

Fig. 9.

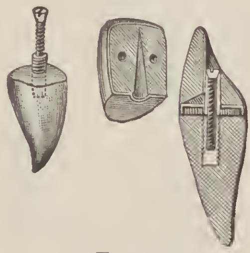


Fig. 10.

exposed surfaces of the porcelain, thereby encapsulating the end of the dowel and the mounting medium, offered opportunities for greater permanency and superior esthetics.

"Richmond" Crown.

In 1880 a type of artificial crown, which became known subsequently as the "Richmond" crown, was patented by Dr. C. M. Richmond. This type of crown consisted of a metal coping adapted to the end of the root, and a facing, similar to the ordinary flat-back facing, which was attached to the coping by soldering.

This type of construction involved the first practical application of a peripheral band to the roots of anterior teeth. As originally designed, it consisted of a band, to which was soldered a floor, thus forming a coping. A facing of special design was attached to the coping by means of a threaded dowel which, passing through the coping, was screwed into a tube mounted previously in the root canal. (Fig. 10.)

The original principle of the "Richmond" crown, however, was soon abandoned, but the modifications and improvements resulting from this suggestion are the basis of the accepted practice of to-day.

Buttner Crown.

The practicability of using a peripheral band in the construction of dowel crowns for anterior teeth was questioned by many, and led to the introduction of the Buttner crown, invented by Dr. H. W. Buttner. The advantages of a peripheral band were recognized and also its possible irritating influences, and this led to an effort to obtain the former and avoid the latter. These features were accomplished by trephining the periphery of the basal end of the root, thus forming a shoulder for the

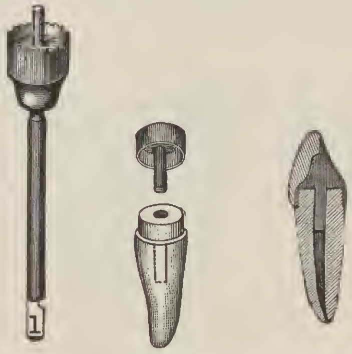


FIG. 11.

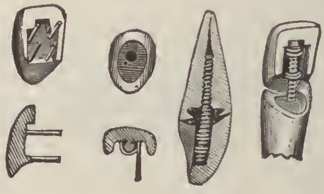


FIG. 12.

accommodation of the band, and this idea, probably, was the progenitor of modern jacket and shoulder crown restorations. (Fig. 11.)

How Crown.

Variations followed rapidly. In 1883 Dr. W. S. How devised a crown which became known as the How crown. This type of crown consisted of a thin facing having four pins, and a lingual surface formed to accommodate a "screw-post" which was anchored to the facing by bending the pins. (Fig. 12.) The facing was backed, and the contour was built up with solder.

Weston Crown.

Another crown of similar type was invented by Dr. Henry Weston in 1883. In the original design the dowel was formed in such manner as to engage the pins, as illustrated in Fig. 13.

This method of attachment was modified subsequently, and the dowel was fixed securely to the root first and the crown was then held in con-

tact with the root and attached by packing amalgam through the opening on the lingual surface. (Fig. 14.)

It will be observed that up to this time crown and dowel consisted of two separate parts. A deviation from this principle followed, and the dowel became an integral part of the crown by being baked into the body of the porcelain.

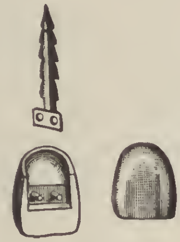


Fig. 13.

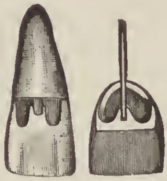


Fig. 14.

Fig. 15A.

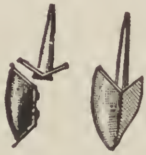


Fig. 15B.

Logan Crown.

The Logan crown was invented and patented by Dr. M. L. Logan in 1885. This type of crown was made in porcelain with a platinum dowel as an integral part. More closely approaching the esthetic requirements than any of its predecessors, its use became popular for a time.

Brown Crown.

Shortly afterward Dr. E. Parmley Brown introduced a similar type of porcelain crown. This crown had the base convex instead of concave, with a view to affording the greatest degree of strength at the line of junction between crown and dowel, and between crown and root. (Fig. 15 A.)

The adaptation of the crown to the root was made by using a bur which produced a concavity to accommodate the convexity of the base of the crown. Because the increased strength of the crown was gained at the expense of the root, however, it was soon abandoned.

Webb Crown.

The advantages to be obtained from a close adaptation of the artificial crown to its supporting root, and the difficulty incident to grinding one surface to fit another, stimulated a desire for better adaptation, and a metal coping was suggested by Dr. M. H. Webb.

The coping was constructed by burnishing or swaging a metal base to fit the end of the root. The base was then perforated to admit the insertion of a dowel into the root canal. The dowel was then soldered to the base, and the facing attached subsequently. (Fig. 15 B.) The possibilities of accurate adaptation, and its advantages, are now generally recognized, and this type of construction is still in common use.

Porcelain Jacket Crowns.

Throughout the evolution of artificial crown work, a desire for methods which might more closely simulate nature, and which might avoid the conspicuous display of gold, has been evidenced. This desire inspired a keener appreciation of the legend "true art is to conceal art," and created a recognition of the full possibilities of porcelain work.

Dentures of platinum and porcelain had been constructed successfully for many years; hence, it was believed that porcelain crowns and bridgework might be constructed successfully also. The porcelain jacket crown followed.

The first suggestions along these lines were made by Dr. C. H. Land. The primitive application met with varying degrees of success and failure, but this was due more to overenthusiasm and faulty technic than to any shortcomings in the porcelain itself, and this type of crown is now recognized as the most ideal method of procedure.

Bridgework.

The first presentation of modern methods of supplying missing teeth by means of bridgework was made by F. Maury in 1828, in a French work entitled "A Treatise on Dental Art." This was translated into English by J. B. Savier in 1843.

Among several illustrations in this book are two wherein remaining teeth, or roots, afford means of attachment for artificial teeth, without any apparent effort to stabilize the fixture by contact with the mucosa.

In 1856 Dr. W. A. Dwinelle suggested that which has been termed the "progenitor of modern bridgework." This embraced a description of a

method of adapting a coping to the end of a root, and attaching an artificial tooth to it. The description was supplemented with the statement that "the plate may be carried across the intervening space unoccupied by roots, and an unbroken row of teeth mounted upon it."

This idea, broadcasted through the profession, brought about a renaissance of methods of greater or less antiquity, and marked the beginning of an era of development which has resulted in the various bridgework technics of to-day.

Fig. 16.

In 1871 Dr. B. J. Bing contributed to this development by devising an artificial tooth made of porcelain, with a platinum bar projecting from each lateral side. The ends of the platinum bar were to be anchored in fillings in adjacent natural teeth. This became known as the "Bing bridge." (Fig. 16.)

While applicable to the replacement of a single tooth only, its introduction marked the advent of the modern application of fixed bridgework.

In 1873 Dr. W. G. A. Bonwill devised a type of removable bridgework in which a metal tube, previously threaded on its inner surface, was mounted in the root canal and used as a means of affording attachment for a removable crown. The crown was adapted to the root and held in position by a threaded dowel which passed through a perforation in its base, and engaged the tube. The attachment was also capable of carrying an adjacent tooth.

Modern dental bridgework, however, had its beginning with the advent of the gold telescope, and the band and dowel type of crown restorations, and its advent, therefore, dates back to the period between 1878 and 1883, when the usefulness of these types of crown restorations was first recognized. Since then the development of methods has been rapid.

From the very beginning, however, it will be observed that there has been an ever-growing tendency toward the development of esthetics. This has resulted in the introduction of many varying methods, embracing a multitude of ingenious ideas. While most of them have been but modifications of original principles, and many were abandoned soon after their introduction, all have aided in the development of modern crown and bridgework, and stand as "records that defy the tooth of time."

Principles and Technics of Crown Work.

CHAPTER II.

INDICATIONS FOR ARTIFICIAL CROWNS.

Since it is not within the province of human effort to improve upon normal conditions, no artificial crown restoration is, or can be, as good as the natural crown of a tooth. And, furthermore, the same state of health that exists in the investing and environmental tissues of the natural crown rarely ever presents about an artificial crown restoration, irrespective of the degree of accuracy obtained in its adaptation to the supporting tooth or root.

Therefore, an artificial crown restoration is indicated as a last resort only, and when no other reparative process, or no other method of attachment for bridgework seems to offer opportunities, or possibilities, for a favorable or permanent restoration.

In the application of artificial crowns the health of the investing and environmental tissues may and will be conserved in proportion as the restoration does, or does not, offer any degree of mechanical irritation.

Evidences of mechanical irritation are quite common, but may be diminished or increased by the accuracy of the adaptation of the artificial crown to its supporting tooth or root. The crowning of a tooth, therefore, may be considered a successful operation in proportion to the skill displayed and the accuracy obtained.

Success in whatever line of art or mechanics depends largely on one's visualizing the completed work. If one has the power to visualize the possible result, before commencing the procedure, creative ideas, so essential to success, are more readily inspired.

The field of artificial crown and bridgework offers splendid opportunities for the attainment of more than average skill, and for the display of the highest artistic talents. Skill and talent alone, however, do not always insure success. Accuracy, facility and deftness in instrumentation must

be acquired to a degree of efficiency that will inspire the confidence of the patient. Details must be observed keenly.

Methods which are quickest are not always best. The operator must be governed by the most conscientious efforts in using judgment and discrimination regarding the particular method most applicable to the case in hand. Often, upon preliminary examinations, several methods seem applicable, but, upon closer study, usually one method in particular will meet all requirements best.

With recognition and appreciation of these basic principles, artificial crown restorations are indicated in three general classes of cases:

First: In extensive loss of tooth structure from the ravages of caries, or from accidental causes.

Second: In occasional cases of malformation, malposition and discoloration in which an artificial crown may offer the best means of insuring usefulness and permanency in the restoration of impaired function, and of affording relief from disfigurement.

Third: As a means of obtaining anchorage for bridgework.

Class I—Extensive Caries. Accidental Causes.

Extensive Caries. The most typical indications for the application of an artificial crown are embraced by those instances where the natural tooth crown has suffered to such an extent from caries as to make restoration by filling, with any assurance of permanency, a negative or doubtful procedure.

In all cases where it seems a question of judgment as to the advisability of effecting the restoration by means of a filling, or by means of an artificial crown, unless for esthetic reasons, the preference should be given to filling, provided that any reasonable degree of success and permanency may be insured.

Frequently, the remaining walls of badly broken-down teeth or roots may be protected and usefulness restored by the insertion of a dowel into one or more of the canals, either as a separate or as an integral part of the filling. Such a procedure is often indicated, and often preferable because of the fact that restoration by means of an artificial crown may thus be deferred. Indeed, a crown may become a remote necessity, for a well-adapted and well-anchored filling is more conducive to the conservation of the normal condition of the investing and environmental tissues than the most skilfully adapted artificial crown.

Accidental Causes. The loss of a portion or of all of the natural tooth crown as the result of a fall, blow, or other accident, or from ab-

normal masticatory stress upon hard substances is by no means uncommon. Such cases usually call for immediate relief, and often the restoration may be most efficiently made by means of an artificial crown.

Class 2—Malformation. Malposition. Discoloration.

Malformation. In conditions of faulty enamel formation, such as conical or "peg-shaped" laterals (Fig. 17), or pitted structure such as is

Fig. 17.

Fig. 18.

found often in the incisors and first permanent molars (Hutchinson's teeth) (Fig. 18), the application of a full artificial crown restoration may be indicated as the best means of affording permanent relief from disfigurement.

Malposition. In cases of simple irregularity, or malposition, of one or more of the anterior teeth (Fig. 19), where the age of the patient, the presence of caries, or other environmental conditions may not seem to warrant correction by the usual orthodontic procedures, the desired re-

sult may often be obtained by sacrificing the natural crown and substituting an artificial one, as the simplest means of correcting the malposition.

Discoloration. A conspicuous and embarrassing disfigurement is often caused by the presence of badly discolored anterior teeth. When the discoloration refuses persistently to yield to repeated efforts at chemical bleaching, an artificial crown may often be indicated as the best and simplest means of effectively and permanently relieving the disfigurement.

Class 3—Anchorage for Bridgework.

Irrespective of the emphasis placed upon the desirability of conserving the natural crowns of teeth, and the possible irritating influence of an artificial crown, the application of artificial crowns may sometimes be indi-

Fig. 19.

cated as the best means of obtaining adequate and permanent anchorage for bridgework.

The use of artificial crowns for this purpose, however, should not be regarded as being indicated generally, nor should an artificial crown be regarded as the only means through which adequate or permanent attachment to the supporting teeth, or roots, may be obtained. But some type of artificial crown restoration often may seem to insure a greater measure of strength and permanency in the replacement of missing teeth than it would be possible to obtain with any other procedure.

The indications for the utilization of artificial crowns as attachments for bridgework, therefore, should be determined only after careful consideration, and must be based on good judgment. The mutilation of the natural crown of a good, sound tooth for any purpose is always a serious and questionable procedure and should never be viewed with indifference.

CHAPTER III.

REQUIREMENTS OF ARTIFICIAL CROWNS.

No superstructure can be more enduring than its foundation; hence no artificial crown of any type can be better or endure longer than its supporting tooth or root.

Hence, when it has been determined that an artificial crown is indicated, every preliminary and basic requirement which may have to do with obtaining and insuring a conservation or restoration of the normal health and function of the tooth, or root, together with its investing and environmental tissues, must be observed. This applies whether the artificial crown indicated is to restore the tooth, or root, as a single unit, or for the purpose of obtaining anchorage for bridgework.

It is essential that the operator should have a broad, general knowledge, first, of the preliminary requirements which are fundamentally necessary to placing such teeth, or roots, as are to support artificial crowns in the most favorable condition possible; and, second, of the basic requirements upon which comfort, usefulness and permanency will depend.

Preliminary Requirements.—These preliminary requirements may be considered in three general classes:

First: Physiological requirements;
Second: Pathological requirements;
Third: Therapeutic requirements.

A recognition and appreciation of the importance of each of these respective preliminary features necessarily must precede a consideration of all others.

Physiological Requirements.

Histology teaches that the dental pulp is the developmental organ of the tooth and that its physiological function practically terminates with complete root-end development. Apparently, therefore, the pulp itself is not necessarily essential to the vitality, health, stability and longevity of the tooth, thereafter, provided that it may be thoroughly and aseptically

removed, and that the root canals may be filled completely under the same conditions, all of which is now recognized as an absolute requirement for health.

It is recognized further that whenever pulp destruction, pulp removal and root canal filling may be accomplished under these conditions, the tooth so treated will receive sufficient nourishment through the peridental tissues to sustain it, and that it may continue its normal functional activity more or less indefinitely, although deprived of its main source of nourishment.

Notwithstanding this generally recognized fact, and irrespective of the highly developed degree of skill attained in the technic and in the application of modern aseptic means in thus removing pulps and in treating and filling root canals, it remains a further indisputable fact that a pulpless tooth is not so good as one having a vital pulp. Invariably, too, there is some element of doubt or uncertainty regarding the thoroughness with which root canals may be completely filled in all cases, and particularly in malformed roots and multirooted teeth.

Pulp Devitalization.—The devitalization of pulps for any reason whatever is a procedure demanding the most serious consideration, and is a practice now justifiable or excusable, only when the requirements permit of absolutely no other course.

With modern technic, and with radiographs as a first aid, there should be but little uncertainty regarding the successful filling of the root canals of all normally formed single rooted teeth. But the uncertainty attached to cases embracing abnormally formed roots, or multirooted teeth, together with the possibilities of reinfection, or of subsequent infection demands most serious consideration of the case in hand.

For many years no special consideration was given to the importance of pulp conservation, nor to the possible serious troubles which might be the sequelæ of pulp destruction and imperfect root canal filling. The devitalization of pulps, in a large percentage of all teeth to be restored by means of some form of artificial crown, was quite generally taught and practiced.

During this period, devitalization was regarded as a preventive measure, and, therefore, as a safer procedure. Several more or less tenable reasons justifying these teachings and practices were given.

First among these it was claimed that the removal of the pulp is necessary in a large percentage of cases as a means of making it possible to shape the remaining tooth crown properly, in order to adjust a well adapted and correctly fitted artificial crown.

In all cases where a crown having a full telescoping band is to be made, and particularly in bicuspids and molars where the remaining natural crown is of typically normal form, the actual mechanical requirements of root preparation are so exacting as to make devitalization a necessity in many cases. Hence, whenever this type of artificial crown must be used, a close adaptation to the supporting root must obtain. And, if the destruction of the pulp is necessary as a means of making this adaptation possible, it is then, to this extent, still a justifiable procedure.

If a suitable restoration might obtain from the use of some other type of artificial crown, however, or from any method other than a crown—one through which the vitality of the pulp may be conserved—such procedure is the better practice.

Secondly, it was a prevailing belief that the application of a full artificial crown with a telescoping band, demanded so much grinding and shaping of the remaining natural crown that disastrous results would follow. Also it was believed that as a result of shock to and overstimulation of the pulp, calcification in the form of secondary dentin, pulp nodules, and other pathological disturbances would follow in many cases.

Such possibilities, of course, would be lessened by the age of the patient, and would become a negative consideration, perhaps, in advanced age, on account of the gradual atrophic degeneration of the pulp, but such a result might be produced in the teeth of young and middle-aged patients.

In any and all cases, however, such a possibility is to be eliminated to a large extent by careful technic, or by conduction anesthesia or nerve-blocking. Hence, it is not now to be regarded as a tenable reason for pulp devitalization.

And, third, it was claimed that the complete inclosure of a tooth having a vital pulp would establish an abnormal condition. It was claimed that the gold crown and the intervening cement would so isolate the tooth from the external influences of moisture and temperature that it would be excluded from its quota of nerve and blood supply, and that the ultimate result would be a complete loss of pulp vitality in many cases.

Such a result, of course, is possible, but the complete abandonment of the full telescoping gold crown is, nevertheless, doubtful. Clinical experience proves that it has afforded many years of useful service in tooth restorations; but even the possibility of such a result, remote or rare as it may be, suggests that the complete enclosure of a tooth having a vital pulp undoubtedly establishes a condition which is not altogether ideal. Therefore whenever and wherever possible, it should be avoided and preference given to some other form or type of restoration which will not endanger the vital pulp even thus remotely.

Pulp Conservation.—From every viewpoint, therefore, it must be recognized that every effort should be made to conserve the vitality of the pulp in all teeth and in all cases. Its destruction, though necessary at times, must be regarded always as a radical procedure and as indicated only when demanded by the requirements of the case. And this is especially important in the teeth of young patients where complete root-end development has not yet obtained.

The final word with regard to pulp conservation, then, may be encompassed in the statement that the vitality of all pulps should be conserved whenever and wherever possible, and that pulp destruction is excusable only when absolutely demanded.

Pathological Requirements.

The treatment of pulpless and infected teeth is recognized as a most important pathological consideration in its relation to the requirements fundamental to the conservation and restoration of the natural teeth by any reparative procedure.

It is especially important at the present time, because some modern writers and teachers of prominence claim that a pulpless tooth is a "dead" tooth. Irrespective of whether the tooth has ever been infected, or whether any attachment of the periapical tissues remain, they claim its retention is a certain and positive menace to health.

These teachings, almost revolutionary in portent, have gained many followers who regard the intrinsic value of the natural teeth in negative terms.

The more conservative writers, teachers and practitioners, however, do not accept such views without question. They maintain that the natural teeth have a valuation in their relation to the human economy far exceeding any form of artificial substitute; and that consequently, every effort should be made to conserve and restore them to health and usefulness, rather than to condemn them at once as being hopeless.

Focal Infection. There is no doubt that root ends of pulpless teeth may become foci of infection. There is no doubt that they may be and often are causative or contributing factors, responsible for distant lesions and general systemic disturbances; but to accept the theory that root-end infection as diagnosed mainly by the radiolucent areas shown in the radiograph is invariably the cause for all hidden or remote physical disturbances, not otherwise so easily traced, and to condemn all pulpless teeth because of this, is to be regarded as a radical and irrational practice. It is also a reflection upon the progress made in the study of the chemistry and

pathology of pulp decomposition and in the scientific teachings of modern dental therapeutics.

Scientific investigation is now being made with a view to obtaining definite knowledge regarding the root ends of teeth and whether specific germs may be traced to them. And, so long as conflicting opinions regarding the relationship between focal infection, associated with teeth, and metastatic diseases in general are held, it is but rational to conclude that a conscientious, well directed effort to save pulpless teeth is safe and sane practice.

The more conservative thinkers along these lines are firm in the belief that the ultimate findings in the solution of the problem will be that a properly treated and well filled pulpless tooth is a safe unit in an otherwise healthy group or environment, and that it may be expected reasonably to perform its normal function indefinitely, much better than any form of artificial substitute.

They are also firm in the belief that if all pulpless teeth are a menace to health, if they must be removed irrespective of the cause of lost vitality or the age of the patient; and irrespective of whether their root canals are properly filled, or whether they have ever been infected; and, if the value and efficiency of the natural teeth, as compared with artificial substitutes of any form, are to be of no consideration whatever, then, until such time as preventive dentistry shall have made restorative and reparative procedures unnecessary, an era of edentulous jaws, inefficient mastication, faulty metabolism, impaired nutrition, artificial dentures and premature old age is inevitable.

It is readily admitted, however, that a knowledge of pathology, a correct diagnosis, and a favorable prognosis are essential to success in determining the borderline of safety in the retention of pulpless teeth. Also, that any effort to eradicate hopelessly incurable pathological conditions is misdirected energy in all cases, and a dangerous practice in many cases.

Every assurance that health, comfort, usefulness and permanency will result, is demanded in all cases and under all conditions in placing an artificial crown upon a pulpless tooth or root, because a moral responsibility for the health of the patient is thus and thereby assumed.

A knowledge of the possible dangers of root-end infections and their sequelæ, and a realization of this responsibility, are absolutely essential and demand—

First: That all pathological conditions must be cleared up, and—

Second: That the canals of all pulpless teeth must be filled thoroughly and their apices sealed hermetically before any permanent prosthetic procedure follows.

Well directed, conscientious effort along these lines, combined with the application of modern technic, and supplemented by the use of radiographs as an aid both to diagnosis and to proving the results obtained, will insure success. Much will depend, however, upon a correct interpretation of the radiograph. While radiographs are not infallible, they are an invaluable guide and an indispensable aid in all cases.

In the light of present knowledge, the prevailing conservative teachings and opinions indicate that every reasonable effort should be made to conserve pulpless teeth, unless absolutely irrefutable evidence of incurable lesions, which may be traced directly to the teeth, be present. If all of the pathological requirements in the composite should not be recognized fully, appreciated keenly and observed carefully, then the removal of pulpless teeth undoubtedly would be the safer and more rational procedure.

As a result of these teachings and of our present knowledge, undoubtedly a more wholesome respect for pulp vitality and its conservation, and a higher regard for the necessity of a more careful and positive diagnosis in the treatment and management of pulpless teeth will prevail.

A summary of the entire subject relative to the retention of pulpless teeth may be stated thus:

All existing pathological conditions or lesions must be cleared up, primarily, and a state of health of the teeth and of their investing and environmental tissues must obtain under any and all circumstances.

This applies also to teeth having vital pulps, and to the eradication of pyorrheal pockets, and other expressions of periodontoclasia.

Therapeutic Requirements.

The therapeutic requirements to be observed in the preparation of teeth and roots which are to support artificial crowns are the same as apply to any form of restoration.

When the requirements of the case demand pulp devitalization, and a correct diagnosis and a favorable prognosis have been made, the necessary therapeutic treatment, which will aid in obtaining and maintaining asepsis and health, should be the first consideration. This is obvious in all efforts directed toward the conservation of pulpless teeth.

In the treatment and filling of the root canals, the isolation of the tooth or root by means of the application of the rubber dam is always indispensable. Its use affords immunity from moisture, facilitates the procedure and reduces the possibilities of reinfection.

In cases where the remaining natural crown may be badly broken down, or entirely gone, the careful fitting of a temporary band will facilitate the

application of the rubber dam to a great extent. The band, if properly fitted, may be worn throughout the treatment and filling of the canals.

When the rubber dam is properly adjusted, the use of the usual therapeutic agencies indicated by the requirements should follow. And they should be continued until thorough and certain asepsis obtains. The root canals then should be filled to their entire length, irrespective of the type of artificial crown to be used. The root filling should be temporarily protected with cement until it has become well solidified.

As the life and usefulness of all pulpless teeth depend upon the thoroughness with which the root canals are filled, the importance of this procedure cannot be overestimated. In every case it is vital that every modern means of insuring success, including radiographic aid and proof, should be observed.

Basic Requirements.

The basic requirements fundamental to the restoration of teeth or roots by means of an artificial crown of any type and upon which comfort, usefulness and permanency will depend, may be classified as follows:

First:—Anatomical requirements.
Second:—Mechanical requirements.
Third:—Esthetic requirements.

Anatomical Requirements.

The first group, designated as anatomical requirements, embraces a consideration, first, of the importance of a reproduction of natural tooth crown formation, and of a restoration of approximal contact and marginal angles; and, second, a knowledge and study of occlusion, and functional activity.

Reproduction of Natural Tooth Form. Since it is quite impossible to hope to improve upon Nature, under normal conditions, a close reproduction of natural tooth form must be recognized as essential to the successful construction and application of artificial crowns of any type.

To this end, a study and thorough knowledge of the typical form of the crowns of natural teeth must be recognized as absolutely necessary. These may be obtained from casts of the normal denture, or from a study of dental anatomy, or both.

Approximal Contact. A restoration of the normal approximating relationship between artificial crowns and the natural crowns of adjacent teeth in any place in the denture is an absolute necessity. It is a considera-

tion of the greatest importance. Only by a good, close contact may the interproximal tissues be protected from the influences of irritation, and normal health maintained. These tissues are so susceptible and so responsive to irritation that the normal condition must be preserved. And, further, without a restoration of good, close contact, proper mastication with any degree of comfort is impossible.

Marginal Angles. Only through a close and careful reproduction of the marginal angles in the restoration of the bicuspids and molars is it possible to secure the greatest efficiency in mastication and the maximum of protection to the investing tissues. Both conditions are absolutely essential to the maintenance of health and comfort.

This requirement is quite as important as that of approximal contact, and, likewise, must be observed.

Articulation and Occlusion.

Heretofore the terms "articulation" and "occlusion" have been used more or less synonymously, and their definitions have been vague, elastic and misleading. Since these terms do not mean the same thing, and for the purpose of aiding in the establishment of a correct terminology, the following definitions, suggested by the Committee on Nomenclature of the American Dental Association, are accepted by the author, and will be used throughout this work.

Occlusion: The contact of the teeth of both jaws, when closed, or during those excursive movements of the mandible which are essential to the function of mastication.

Centric occlusion: The contact of the teeth when the jaws are closed in the position of rest.

Eccentric occlusion: The contact of the teeth in the excursive movements of the mandible.

Functional occlusion: Such contact of the teeth of both jaws as will provide the highest efficiency during all the excursive movements of the mandible which are essential to the function of mastication, without producing trauma.

Traumatic occlusion: Such contact of the teeth of both jaws as would induce trauma during centric or eccentric occlusion, because of the malposition of the teeth, or the disarrangement of the occlusal planes.

Malocclusion: Such malposition of the teeth as will interfere with the highest efficiency during the excursive movements of the mandible

which are essential to the function of mastication. This would not necessarily indicate lack of occlusal contact when the jaws are closed, nor would it always indicate traumatic occlusion.

Articulation: The arrangement of artificial teeth to conform to the requirements of the edentulous space, or spaces, which they are to occupy, and to adequately serve the purposes of the natural organs which they are intended to replace.

Articulation refers to the actual placing of artificial teeth, one by one, into required position; but articulation is not to be used to describe the occlusal relations of artificial teeth after they have been arranged.

Functional Activity.—Function is the keystone of occlusion, and only through the establishment and maintenance of functional occlusion is resistance sustained and disease prevented.

A restoration of the normal functional activity of the supporting tooth or root, and the degree of usefulness, comfort and permanency of an artificial crown, or any other form of restoration, depends largely upon an accommodation for functional occlusion during the process of articulating the artificial substitute.

Therefore, it is necessary to make every effort to reproduce the natural tooth form for the accommodation of all movements and excursions of the mandible.

The result of faulty or imperfect occlusion usually manifests itself in the form of more or less acute peridental inflammation, followed by looseness and soreness, finally resulting in traumatic occlusion, which is often the direct cause of broken crowns or of fractured roots.

Thus it will be observed that the requirements of articulation and occlusion are highly important, and a part of crown and bridge construction that cannot be overlooked nor underestimated.

Indeed, it is such an important feature that carbon paper, or other similar material, such as lampblack mixed with vaseline, is essential in the final adjustment of all forms of restoration to meet these requirements.

Mechanical Requirements.

The second group of requirements may be designated as mechanical, and embrace a consideration of the essential features of first, adaptation; second, stress; and third, strength; all of which bear materially upon comfort, usefulness and permanency.

Adaptation. The susceptibility of the investing and environmental tissues to any degree of mechanical irritation, and the more or less irrep-

arable injury to health and function resulting therefrom, together with an appreciation of the further requirements of prevention, demands that an artificial crown be adapted to its supporting root accurately. The adaptation must be sufficiently accurate to preclude the possibilities of undue irritation.

This means that an artificial crown must "fit' both the basal end and the periphery of the root, irrespective of the type of crown used. In proportion as a conservation of the continuity of the root obtains, the degree of accuracy of adaptation between crown and root increases. Hence, in proportion as the "fit" is good or bad, the possibilities of irritation will be decreased or increased.

In other words, the better the crown fits the root, the less the irritation produced and the greater the health of these tissues; and the greater the health of these tissues, the greater the comfort and permanency obtained.

Thus, it is evident that an artificial crown should be so constructed and so adapted as to offer but little, if any, irritation to these tissues. And, to this end, every precaution which will aid in avoiding irritation must ever be observed.

Furthermore, the possibilities of subsequent disintegration of the supporting tooth or root from caries, or of a dissolution of the mounting medium, either of which, sooner or later, would result in failure, are minimized, or eliminated entirely, by the degree of accuracy obtained in the adaptation. Thus, it will be observed, that permanency, as well as health, depends upon accuracy.

Stress. All of the teeth in the normal denture are subjected to the influences of stress in different directions in accordance with their functional requirements and activities.

The findings and teachings of Prof. G. V. Black have proved that the natural teeth in a normal denture are capable of sustaining stress to a degree that varies from one hundred and twenty-five pounds to two hundred and fifty pounds; and, in some instances, even more, according to the size of the teeth, the density of their supporting structures and the power of the masticatory muscles.

Any type of artificial crown, therefore, must be constructed and attached to its supporting tooth, or root, with a view to withstanding this degree of stress and to accommodate any and all variations.

The line of the greatest natural resistance to stress is in a vertical direction. Hence, every precaution should be made to prevent undue or unnatural stress in any other direction. It must be remembered that no tooth, or root, will accommodate abnormal stress to any great degree in

any direction, other than vertical, and remain permanently comfortable and healthy.

The stress assumed by the six anterior maxillary and mandibular teeth tends to force them outward and forward. These natural tendencies are to be accommodated only by a close observation of the requirements of root preparation, restoration of approximal contact and the method of attachment of the artificial crown to the root.

The functional activities of the bicuspids cause them to receive stress in both vertical and lateral directions. Provision must be made for this stress in the same manner, though perhaps not to the same degree, as indicated in the restoration of the anterior teeth.

The molars are least susceptible to displacement, due to the fact that lateral stress is limited in proportion to the degree of the normal accuracy of occlusion. And, as the greatest stress is in the direct, or vertical line, the essential requirement is a good, firm seating, supplemented by accurate occlusion.

Strength. Inherent strength, both in the crown itself and in the method by which it is attached to its supporting tooth, or root, is an essential to the mechanical requirements of crown construction.

It must obtain to a degree that will be adequate to the demands of stress in any type of crown and in all cases. Even the always desirable feature of esthetics must be sacrificed sometimes to insure a degree of strength necessary to meet these requirements.

Attachment to Supporting Tooth.

Two distinct mechanical principles are the basis of adequate strength in attaching artificial crowns to their supporting teeth, or roots. Both of these principles are indicated, first, by the type of crown to be constructed; and, second, by the exposed surface of natural tooth crown remaining, and to which the attachment may be made. These involve the telescoping principle and the dowel principle.

Telescoping Attachment. Wherever enough of the natural tooth crown remains to insure adequate strength in the attachment of an artificial crown by telescoping over it, the principle may be used successfully. If the artificial crown may telescope over the remaining natural crown equal to one-half of the length of the artificial crown, from the gingival line to the incisal edge or occlusal surface, adequate strength in the at-

tachment will obtain. And this strength increases in proportion to the increase in length of the telescoping surface contact.

Dowel Attachment. Wherever all of the remaining natural crown must be, or is already, sacrificed to the gingival line, leaving no opportunity for the adoption of the telescoping principle, a secure mechanical fixation of the crown to the root may be obtained by extending a dowel of proper size into the root canal to a distance equal to the length of the artificial crown.

The dowel may or may not be an integral part of the artificial crown, but must be attached securely thereto.

This method of attachment is indicated in the restoration of all anterior teeth or roots, with any type of crown, other than the porcelain jacket, in order that the esthetic requirements may be observed.

Esthetic Requirements.

Esthetic requirements embrace a field of effort giving the greatest possible scope to individuality and artistic talent on the part of the operator.

An artificial crown should preserve the gingival outline and the symmetrical alinement of the adjacent teeth to comply with the highest attainments in esthetics. It should be of the same length as the adjacent teeth, and, if of porcelain, it should match them closely in color. And, if within the range of vision, it should correspond in general form and in type and characteristics with the corresponding tooth in the opposite side of the natural denture.

Where porcelain is used, no metal should be visible unless displayed to conform more closely with the adjacent teeth or corresponding tooth.

Where the remaining natural teeth are filled freely with the gold, small fillings in the artificial crown produce a greater degree of harmony with its neighbors thus making detection more improbable. Legitimate deception is true evidence of art and Nature's great law of harmony should be observed always.

Epitome.

The requirements of an artificial crown, in the composite, epitomized, are as follows:

First: The primary requirement is essentially the health of the supporting tooth, or root, and of its investing and environmental tissues.

Second: It must restore the typical anatomical form of the natural crown, including marginal angles, cusps, sulci, embrasures, and approximal contact with adjacent teeth.

Third: It must meet all the requirements of articulation and occlusion, and normal function.

Fourth: A restoration of the peripheral continuity must obtain between crown and supporting tooth, or root, with a degree of accuracy that will offer no mechanical irritation to the investing and environmental tissues, and which will insure protection from subsequent caries and permanency in the attachment.

Fifth: A degree of inherent strength adequate to the requirements of stress must obtain, both in the crown and in the method of its attachment to the supporting tooth, or root.

Sixth: It must preserve the symmetrical alinement of the adjacent teeth. And, if within range of vision, must match them closely in size, type and color, and simulate the corresponding tooth on the opposite side of the natural denture. And, all unnecessary display of gold or other metal should be avoided.

CHAPTER IV.

METALLURGY.

The metals and their alloys, their characteristics, physical properties and methods of manipulation, play an important part in the field of oral restorations.

A study and a broad and comprehensive knowledge of dental metallurgy, therefore, is a requirement scarcely second in importance to those which have been designated as basic.

It is not now necessary for the dental prosthetist to be an expert metallurgist, or to refine, alloy, or otherwise prepare his metals for any and all special purposes. This is done better and much more scientifically by reliable dental gold manufacturers. But the acquirement and development of skill in manipulation of these special products is necessary at all times.

The Metals.

Organic chemistry teaches there are fifty-two known metallic elements. Of these it is necessary to consider only those which are used more or less generally in dentistry. They are included in the following table:

		Fusing Point	
Metal	Symbol	° F.	° C.
Gold	Au	2016	1102
Platinum	Pt	3632	2000
Iridium	Ir	More refractory than Pt.	
Copper	Cu	1996	1091
Silver	Ag	1873	1023
Zinc	Zn	773	412
Lead	Pb	617	326
Tin	Sn	442	228
Bismuth	Bi	507	264
Cadmium	Cd	442	228
Antimony	Sb	842	450
Alumini	Al	1292	700
Iron	Fe	3000	1600
Nickel	Ni	3000	1600

Expert gold and platinum smiths are not metallurgists, necessarily, but they are master manipulators of metals. And the requirements of modern crown and bridgework now demand that the dentist, too, should be in possession of similar knowledge and craftsmanship.

Classification of Metals.

Metallurgy divides the metals into two groups, known as noble and base, and so classified because of their affinity for and property of combining with oxygen.

Noble Metals. The noble metals have less affinity for oxygen, do not combine with it so readily, and are more easily separated from its combinations when subjected to heat.

The noble metals are gold, silver, platinum, and iridium.

Base Metals. The base metals have a much greater affinity for oxygen, combine with it more readily, and are separated from it with more difficulty because their compounds are not decomposed by heat.

The base metals are copper, tin, zinc, lead, bismuth, cadmium, antimony, aluminum, iron and nickel.

Physical Properties. All metals of both groups possess distinctive physical properties. To facilitate the skilful manipulation of those used more or less extensively, it is essential that one should understand thoroughly the nature of the metals and their alloys.

Chemical Action. All metals are more or less susceptible to the chemical action of the oral secretions. Gold and platinum are the least affected. Platinum withstands any action, and permanently retains its color and luster much better than gold. This is due probably to the fact that platinum is used mainly in its pure state of fineness, while gold, nearly always, is alloyed with one or more of the base metals.

The action upon gold in its pure state of fineness is practically the same as upon platinum. But, under the influence of the oral secretions at body temperature, it oxidizes and tarnishes in direct ratio to the proportion of base metals used in alloying or in reducing to the state of fineness.

It is recognized that the soft tissues seem to tolerate, or take more kindly to platinum than to gold—probably due to this superficial oxidation, characteristic of the latter.

Odor and Taste. All metals have a distinct odor and taste, but noticeable only to an infinitesimal extent.

Copper and zinc carry the most distinct metallic odor and taste. This

is of no special importance, however, for they are used merely for the purpose of alloying and the odor and taste are apparent only when they are subjected to a temperature higher than body temperature.

Color. Each metal possesses a characteristic color. These colors vary from the grayish-white of platinum and silver, to the muddy blue of lead, and from the rich, bright yellow of gold, to the dark, red-dirt color of copper. The color of all metals is modified by alloying.

Gold and platinum possess color and luster that, in contrast, is more pleasing to the eye, more in harmony with the environment and least susceptible to change by the chemical action of the oral secretions.

Malleability. Malleability is an inherent property of a metal which admits of its being hammered, or rolled, into thin sheets without destroying the continuity of its surface, and permits of its easy manipulation and adaptation.

Ductility. Ductility is the property which admits of metals being drawn out into lengths of a small diameter, such as wire.

Tenacity. Tenacity is the property of molecular resistance to tension upon which depends the strength of the metal.

In studying the accompanying table, it will be noted that gold, while ranking first of the five principal metals most commonly used, in malleability and ductility, ranks last in tenacity. This, of course, refers to pure gold, the tensile strength of which is greatly increased by alloying with copper, silver or platinum.

	Malleability	Ductility	Tenacity
Rank 1:	Gold	Gold	Iron
Rank 2:	Silver	Silver	Copper
Rank 3:	Copper	Platinum	Platinum
Rank 4:	Platinum	Iron	Silver
Rank 5:	Iron	Copper	Gold

Density. The density of metals depends upon the intimacy of the relationship or contact between the molecules. This property is influenced by expansion and contraction, by the temperature to which it is raised and the rapidity with which it is cooled.

Fusibility. All metals are capable of being reduced to a fluid state under the influence of heat. But like the color, the fusing point, or degree of fusibility, differs greatly and is modified by alloying.

The high fusibility of platinum of any thickness greatly facilitates some classes of work; and the control, at will, of the fusing point of gold,

by alloying, makes the assemblage of innumerable parts and the art of soldering comparatively easy and simple.

Physical Processes.

The physical processes which concern the dentist mostly in the manipulation of the metals are those of soldering, welding, annealing, tempering, and alloying. A knowledge of each is important.

Soldering. Soldering is the process of uniting surfaces of metal by superficial alloying.

Welding. Welding is the process of uniting surfaces of metal by molecular attraction under heat and pressure.

Annealing. Annealing is the process of softening, or increasing malleability. As all metals expand under the influence of heat, they, in turn, become softened because of the separation of the molecules produced by expansion.

To accomplish this, they should be heated slowly to a cherry red and allowed to cool gradually. Plunging gold or platinum into water, however, does not interfere with the process of annealing; and to plunge either into alcohol seems even to increase their softness.

Tempering. Tempering is the process of hardening. In gold, platinum, silver, copper, etc., it obtains as the result of manipulation, due to molecular condensation. Iron containing carbon (steel) is tempered by sudden thermal changes from various degrees of heat. This produces hardness in proportion to the quantity of carbon present, and the manner and method of cooling.

Alloying. Alloys are a combination of two or more metals and alloying is, of course, the process of combining metals. A study and knowledge of this art is important, because so few metals now used are in their pure state.

Most metals enter freely into combination with others and the alloy produced frequently possesses characteristics entirely different from those of any one of the component metals. They always fuse lower than the highest fusing and often lower than the most easily fusible. In compounding them, the least fusible usually should be melted first in a clean crucible, and the others added in relation to and in accordance with their fusibility, after first carefully weighing out the proper proportions.

Alloys of gold, copper and silver can be melted and incorporated al-

most simultaneously, with comparative ease. Those containing platinum or zinc are more difficult. Platinum, usually, is added by feeding it into the molten mass in thin foil form. Zinc is best incorporated in the shape of brass, or some other alloy of known formula, because of the rapidity with which it volatilizes.

When zinc is to be added in the pure state, the proper quantity should be weighed, broken into small pieces and each piece coated with a film of paraffin, or wax, then thrust quickly into the molten mass.

In compounding alloys it is necessary to be familiar with the table of troy weight commonly used by metallurgists.

Troy Weight

24 grains (gr.)		1 pennyweight (dwt.)
20 pennyweight (dwt.)	=	1 ounce (oz.)
12 ounces (oz.)		1 pound (lb.)

Scale.

lb.	oz.	dwt.	gr.
1	12	240	5760
	1	20	480
		1	24

Field of Usefulness of Metals.

Each of the metals and its alloys has a distinct field of usefulness as applied to crown and bridgework. This field will be considered in the order of each metal's relative value for various purposes.

Gold. The color, malleability, compatibility and slight susceptibility to the chemical action of the oral secretions and other qualities possessed by gold, make it easily the nearest approach to the ideal for universal use. While the highest artistic and esthetic efforts should be directed toward avoiding its conspicuous display as much as possible, its sphere of usefulness is unlimited.

Owing to its softness, the uses of pure gold necessarily are limited in prosthetic procedures. Its use is confined usually to backings for porcelain facings, crown copings, etc., where a close adaptation is desired and where it is afterward to be reinforced.

Karat. Twenty-four is the quotient used to denominate purity. In alloying gold the term karat is applied to the degree of fineness. Thus, karat designates the proportion of pure gold to the ratio of 24 parts. Hence, 24 K. is virgin gold, while 18 K. is composed of 18 parts of gold and 6 parts of other metal or metals used for alloying.

Platinum. Platinum has rapidly acquired an extensive field of usefulness in dental art, and, because of its many admirable physical properties, is second only to gold.

The properties of malleability and practical infusibility are valuable and have made possible the successful application of porcelain work in all of its various phases. It withstands the chemical action of the secretions so much better than gold that it ranks first in compatibility with the tissues. It is used extensively also in alloying gold, to which it imparts special properties.

Iridium. The physical properties of iridium resemble platinum, but are more refractory. Its use is confined to alloying with platinum, the combination forming a tougher, harder alloy, such as is indicated in casting alloys, and in other instances where more than ordinary strength is required.

Alloys.

Alloys of Gold. For the purpose of reducing the fineness and increasing the strength of pure gold, copper and silver mainly are used for alloying, usually in the proportion of two parts of copper to one of silver. Copper imparts hardness and strength and silver imparts pliability and a preservation of the original color, which copper alone would change.

For crown and bridgework, where strength and good color should be combined and are prerequisites, the gold most generally used to the best advantage is of about 22 K. fineness. This is necessary to resist or to secure immunity from the chemical action of the secretions, retain its color and luster and withstand the stress. It is used in rolled plate and of a thickness varying from 28 to 30 United States Standard Gage.

The following are three basic formulæ used for this purpose:

No. 1—22 K.

Pure gold	22 dwt.
Pure copper	1 dwt.
Pure silver	18 gr.
Platinum	6 gr.

No. 2—21.6 K.

Pure gold	90 parts
Pure copper	5 parts
Pure silver	5 parts

No. 3—21.6 K.

Coin gold	50 parts
Pure gold	45 parts
Pure silver	5 parts

Coin Gold. The United States coinage—gold 90, copper 10—for many years was the means of furnishing an alloy which was used extensively. It is, perhaps, not used so extensively now because of its hardness and because of the characteristic reddish color, which is not particularly pleasing to the eye when contrasted with the bright yellow of a pure gold filling.

Coin gold may be used to good advantage, however, in combination with pure gold and silver in proper proportions, because of the definite knowledge of the proportion of copper it contains.

Gold and Platinum Alloy. Platinum in various proportions is used as an alloy for gold wherever additional strength, elasticity and increased fusing point are desired. Platinum, varying from 5 per cent to 10 per cent, gives these properties to the alloy.

Platinized Gold. "Platinized" gold is a form of drawn plate made by fusing pure gold over one surface of platinum, which, when passed through rollers, presents a smooth, unbroken surface of each metal. It is used where extreme thinness and greater infusibility is desirable. It is used also for backings for porcelain facings, because of the advantage of controlling or preserving the color by placing next to the porcelain that surface which will cause the least change, or produce the most desirable change.

Casting Alloys. The advent and successful application of the casting process has almost completely revolutionized the character and requirements of alloys of gold and platinum used for other purposes. It has created a demand for various kinds of alloys, each one possessing special physical properties and characteristics which make it applicable to the requirements for some particular line of casting.

The casting of a metal, or of an alloy, brings about an entirely different arrangement of the molecules and results in a product entirely different from that which the same metal, or alloy, would produce if rolled or drawn. This molecular rearrangement undoubtedly diminishes the inherent strength and increases the brittleness of all alloys.

Gold and platinum are, of course, the basic metals in compounding alloys for casting. Pure gold is easily and successfully cast, but the casting is too soft for any purpose other than inlays. And, even in inlays, 22 K. gold is generally used. It is regarded as better than pure gold because of its better retention of form and contact under the influence of stress.

For the same reason 22 K. gold is recommended generally for castings

for crown and bridgework in all cases where accuracy of adaptation is paramount to strength.

But where strength and elasticity in the casting are required, it becomes necessary to combine various other metals which will impart the desired physical characteristics, and also add to the flowing and spreading properties of the alloy.

An alloy which flows and spreads smoothly is cast more easily. It also casts to the finer details of the mold with greater accuracy than a heavy, sluggish alloy. Therefore any combination of metals designed to meet special requirements must be worked out along scientific lines.

The scientific compounding of alloys discloses the fact that those combinations which will produce and insure desirable requirements in fusibility and in efficiency after casting, and, particularly, those of the harder and more springy class, will show necessarily a greater tendency to oxidize in melting and casting. This tendency to oxidize, however, is not especially injurious to the casting and may be taken care of by the use of the proper reducing flux. If this precaution is not always taken, the alloy is likely to be sluggish and to cast indifferently.

Scientific tests prove conclusively that it is not possible to compound an alloy suitable to the requirements and possessing desirable physical characteristics which will not oxidize under the influence of heat.

The overheating of any alloy in melting should always be avoided, however, as this increases oxidation. The higher the heat, the greater the tendency of an alloy to absorb oxids; hence, when brought to a white heat, and when boiling and sputtering, an alloy is too hot to be cast.

An ideal condition for casting any alloy is immediately after the surface coating breaks and a mirrorlike surface presents. And, as long as the alloy is molten, the cooler it is at the time of casting, the smoother will be the casting. But the greater the disturbance caused by excessive heat, the less accurate and smooth will be the casting. And, furthermore, great care must be taken always in melting an alloy to guard against carbonizing and oxidizing influences.

Solders.

Platinum Solders. The advent of procelain work and the use of high-fusing porcelain compounds on a base of platinum demand a solder more infusible than pure gold. This is necessary in order that joints so made will not be affected by the high degree of heat necessary to fuse or vitrify these compounds.

If there is *absolute contact* of the parts to be united by soldering, pure

gold may be used successfully in small pieces; because if thoroughly fused it will be absorbed by and alloy with the platinum. But, in extensive work, platinum solder is an advantage because its use overcomes the possibility of any change in the relation of the parts which may be caused by the shrinkage of the porcelain compound in fusing.

Platinum solders are now prepared for this purpose, varying in the percentage of platinum in combination with gold. Less than 20 per cent platinum is of no advantage, and more than 25 per cent is unnecessary.

Gold Solders. Gold solders are alloys of gold so compounded as to fuse slightly lower than plate gold of the same fineness, or karat. They should be composed of the same metals in order to preserve a close resemblance in color, and differ only in the incorporation of a base metal which will reduce the fusing point and impart flowing properties. Thus 20 K. solder, for instance, should fuse readily on 20 K. plate; otherwise it would not be a "solder."

Zinc and bismuth are used mostly for reducing the fusibility and imparting the requisite flowing properties. They should not be used in greater proportion than 1½ to 2 parts in 24, however. If incorporated in greater quantity, the alloy would be rendered brittle, the strength diminished, and the susceptibility to chemical influences increased when exposed to the action of the oral secretions.

Solder of a lower karat than is absolutely necessary should never be used. The lower the karat the greater the susceptibility to chemical action and to oxidation. Consequently, the joint and all exposed surfaces are rendered more or less conspicuous. It is always desirable to use solder of as high karat as possible to begin with so that subsequent solderings may be made with a degree of fineness of solder which will aid in precluding this tendency.

All grades of solders invariably run lower than the karat stamp upon them; hence 16 K. and 14 K. solders have but a very limited field of usefulness.

The following formulæ will give an idea of the average composition of the various grades of dental solders:

22 K. Solder

Pure gold	22 parts
Brass	2 parts

Coin Solder

Coin gold	5 dwt.
Brass	1 dwt.

20 K. SOLDER

Pure gold	20 parts
Dorrance's alloy	4 parts

18 K. SOLDER

Pure gold	18 parts
Pure silver	3 parts
Pure copper	1 part
Brass	2 parts

Compounding Solders.

Because of the ease with which the various karats of plate golds and solders may be procured now by the dentist, it is scarcely necessary to be familiar with the methods used in ascertaining and computing the fineness of gold. But, as it may be desirable sometimes to compound solders, it is well to know the method of reducing scrap gold of known fineness to the various karats of solder desired.

The following simple rule will enable any one to reduce a given quality of scrap gold of given fineness to any desired karat of solder:

Rule for Compounding Solders.—Multiply the weight of gold by the karat and divide by the *desired* karat. The difference between the answer, *after dividing,* and the *original quantity of gold,* is the proportion of alloy necessary to be added.

Example. Reduce 4 dwt., 3 gr., 22 K. gold to 18 K. solder.

4 dwt., 3 gr. (original quantity) equals 99 gr.

99 × 22 (original karat) equals 2178.

2178 divided by 18 (desired karat) equals 121.

121 minus 99 (difference between result and original quantity) equals 22.

Answer: 22 gr. of alloy should be added.

Base Metal Alloys.

For the purpose of compounding solders, the alloy used should contain copper and zinc, or silver and zinc. Such alloys may be obtained in convenient form in known formulæ, such as brass, Dorrance's alloy, or silver solder.

Brass. Brass is composed of copper and zinc in proportions suitable for the purposes for which it is to be used. The proportions usually vary

from equal parts of each, to 70 of copper and 30 of zinc. Owing to the close resemblance to gold in physical properties, characteristics, and even color, brass is much used in various lines. When used as an alloy for gold in compounding solders, its definite formula should be ascertained.

Dorrance's Alloy. An alloy, known as Dorrance's alloy, is used extensively in reducing gold to solders. It is a combination of the three principal metals used, in good proportions, with copper in the preponderance. Following is the formula:

Copper	6 parts
Silver	2 parts
Zinc	4 parts

Silver Solder. Silver solder is an alloy of copper, silver and zinc, with silver predominating. It is used extensively in making gold solders. Being a "hard" solder it is used also in various lines of work embracing brass and German silver. A common formula follows:

Silver	6 parts
Copper	3 parts
Zinc	1 part

German Silver. The alloy known commercially as German silver is used to some extent for temporary purposes and temporary work of all kinds. It is composed of copper and zinc, in combination with nickel, which metal increases the fusing point and makes a harder, tougher alloy. The following formula is much used:

Copper	50 parts
Zinc	30 parts
Nickel	20 parts

Fusible Alloys. Fusible alloys are those alloys in which the lower fusing base metals, such as lead, tin, bismuth, antimony and cadmium are combined in varying proportions. They are useful for making dies and counter-dies for swaging, and for the purpose of obtaining casts directly from plaster, or compound impressions, or from "mouldine" compounds.

The extreme fusibility of these alloys depends, to a large extent, upon the proportion of bismuth incorporated, and varies accordingly.

The following are formulæ of some of the various well-known alloys, with their approximate fusing points:

No. 1

Bismuth	5
Lead	4
Tin	2
Cadmium	1
Fusing point	140° F.

No. 2

Bismuth	8
Lead	8
Fusing Point	174° F.
Tin	3

No. 3

Bismuth	8
Lead	5
Tin	3
Fusing point	200° F.

No. 4

Bismuth	8
Tin	5
Lead	3
Fusing point	220° F.

The lower fusing of these alloys may be cast or poured directly into plaster, gutta percha or compound impressions. But they never should be overheated in melting, and should be cast just before they begin to congeal.

Soft Solder. The use of soft solder in dentistry may be indicated sometimes in temporary work. Ordinary tinner's solder is composed of equal parts of tin and lead. Any of the fusible alloys will answer the purpose equally as well. Zinc chlorid is the "flux" for soft solder.

Flux for Base Metals. Base metals and their fluxes are used in the dental laboratory only in exceptional operations.

The best flux for lead is resin. Paraffin, wax, Burgundy pitch, gum dammar, gum copal, etc., have the same properties as rosin, but are no better and are much more expensive.

Tallow and palm oil are used for tin, and sal ammoniac is the flux used for zinc.

Refining Scrap Gold.

The scrap gold that accumulates in the laboratory often becomes so contaminated with base metals that it could not be melted and used over again without first having been subjected to some simple process of refining.

The Roasting Method. When the scrap is composed mostly of a known degree of fineness, the refining may be accomplished quite easily without resorting to the chemical process, by what is known as the "roasting" method.

This consists of placing the scrap in a clean crucible with plenty of borax. Heat then is applied until a perfect fusion is reached, when small pieces of potassium nitrate (saltpeter) should be added consecutively; or,

equal parts of borax and potassium nitrate may be mixed together previously, and then added.

This oxidizing agent furnishes sufficient oxygen to oxidize all base metals and the oxids are absorbed by the borax. If kept up long enough, the gold will be refined sufficiently to be used over again.

Recovering and Refining Waste Gold.

The average dentist, probably, does not have time, nor the facilities, for recovering the waste gold that daily finds lodgment in, or becomes attached to sweepings, rugs, carpets, disks, strips, etc., yet the method usually employed in reclaiming and refining it may be of general interest.

The Wet Method. The sweepings and such various articles as may contain gold are placed first in a suitable vessel. Then they are subjected to a degree of heat in a blast furnace which will reduce them to ashes and residue which, afterward, is powdered finely.

The next step is to separate the gold from most of the ash, carbon, sand, etc., by the mechanical process of *washing*. During this process, because of the high specific gravity of the metallic masses, they seek the lowest point, allowing the residue to remain on top.

The gold may be extracted from the remaining mixture of heavy materials by the following method:

Treat with nitrohydrochloric acid (aqua regia); heat gently; agitate occasionally; and then allow the mixture to stand for a few hours.

The solution now is evaporated until all free acid has been expelled, when it is allowed to cool and alcohol and potassium chlorid are added, precipitating any platinum that may be present.

The gold then may be precipitated from the *filtered* solution by adding ferrous sulphate, C. P.; or, by heating it with a solution of oxalic acid, when the precipitate, a fine, brown powder, should be washed with distilled water, placed in a graphite crucible and fused thoroughly with potassium nitrate (saltpeter) or borax, or a combination of both, as previously indicated.

CHAPTER V.

IMPRESSIONS AND CASTS.

In the building of crown and bridgework much of the detail of adaptation may be executed directly upon the supporting teeth and roots in the mouth, but the actual details of construction must be done upon what may be termed a reproduction of the normal foundation.

Hence, a means of obtaining this reproduction with certainty and accuracy, and of thus transferring the field of work from the patient to the laboratory, is necessary.

This reproduction of the normal foundation is obtained, primarily, by means of a mold or of an impression. No reproduction is ever as accurate as the original, however, and no reproduction can be any more accurate than is the means by which it is obtained.

A *mold* or an *impression* of the teeth, roots and associated parts, therefore, and one as accurate as it is possible to obtain, is essential to an equally accurate *reproduction,* or *cast.* And an accurate cast is the equivalent of an accurate means of transfer from patient to laboratory.

Too much emphasis, therefore, cannot be given to the importance of exercising every effort, first, to obtain a good, accurate impression, and, second, to obtain as a resultant a good, accurate cast.

Cast or Model.

The cast or "model" which is to become the foundation upon which all of the technical details of construction are to be completed must be not only an accurate reproduction, but also must possess strength and indestructibility adequate to the requirements.

The terms "cast" and "model" are generally, but wrongly, used more or less synonymously. *Cast* means that which is obtained by pouring or otherwise introducing a plastic substance into a mold and subsequently separating it therefrom; *model* means a pattern or an object to be copied.

The impression, then, becomes the mold and is filled with a plastic substance that subsequently crystallizes and is separated therefrom. The re-

sultant is the cast. Being scientifically correct, therefore, the term *cast* is to be used exclusively. Its use should become general.

Impressions.

The impression is the intermediary between the original foundation and its replica, or reproduction. It is the means of transferring not only the foundation itself, but also various parts of the work in process of construction.

Regardless of the talent or the skill displayed in building the superstructure, its adaptation can be no more accurate than the cast upon which it is built; nor can the cast be more accurate than the impression from which it is obtained.

Thus, if accuracy is to obtain at all, it must begin with the impression. For this purpose two materials are used—plaster of paris and impression compound.

Plaster of Paris. The requirements of accuracy demand the use of a material for impressions which will be applicable universally and dependable always. Plaster of paris is absolutely the only substance which will subscribe to these demands. It will not draw nor pull in removing; it will fracture before it is distorted and it is this feature that insures accuracy.

A good grade of "impression" plaster should "set," or crystallize quickly. The rapidity of crystallization may be controlled by the use of potassium sulphate or sodium chlorid.

Impression Tray.—A form of impression tray suitably adapted to the requirements of the case should be selected and care should be exercised; first, to have the mix as thick as can be used without danger of setting too rapidly; second, to avoid any unnecessary surplus; third, to adjust it to place accurately in the mouth; and fourth, to hold it firmly in position until crystallization begins.

As soon as a small surplus piece of the same mix may be broken to a clean fracture between the fingers, the impression should be gently, but firmly, loosened, but not removed. It should then be allowed to remain until well crystallized. To loosen it before it becomes thoroughly crystallized will cause it to fracture easily, where fracture is to be, thus facilitating the subsequent detachment and removal. It also diminishes the strain placed upon the remaining natural teeth in its removal.

If the tray used has been prepared previously in a manner which will insure the removal of the body of the impression with it—a precaution

always to be observed—it is of little consequence if the impression is fractured into any number of pieces. If all pieces are reclaimed they may be replaced in their proper relation and sustained in position with melted wax.

Another method which will be found very effective in insuring an accurate impression, requires that the impression tray be kept bright and smooth, and it is well to advise the patient that the tray, when removed,

Fig. 20.

will leave the plaster in the mouth. As soon as the plaster has thoroughly crystallized, the tray is removed, and the plaster scored in suitable places to permit the plaster which is towards the face to be broken off, usually in three pieces, after which the part against the palate usually is readily removed in one piece. But whatever number of pieces there may be, they are to be thoroughly washed under a running water faucet, to remove minute particles. The tray is also similarly washed, after which the pieces of plaster are assembled in the tray, rather loosely. When all are properly placed, they can be forced into correct and very close relationship, the tray acting as a restraining matrix.

For single crowns and small bridges, simple crown and bridge impression trays are used. These are made in several designs. One is adjustable and adapted to universal use. The others are adapted to unilateral application only, and are designated as right and left. By transposing, they are applicable to both upper and lower arches. (Fig. 20.) For larger cases the ordinary partial or compound impression trays are used. (Fig. 21.)

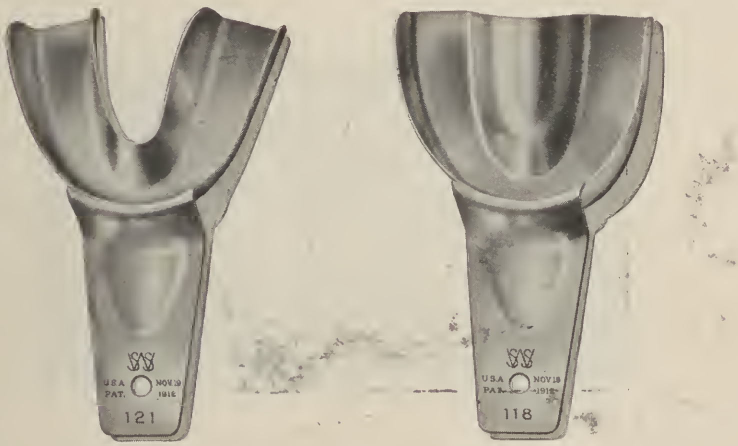


FIG. 21.

Where any of the parts of work under construction are to be removed with the impression, it should be noted carefully that they are in their proper positions and held securely. This precaution is very important.

Assured that the impression is sufficiently accurate and satisfactory in all its details, it should be allowed to dry and then be varnished with some preparation that will insure and facilitate separation.

Separating Fluids. Any good separating fluid which will insure separation, afford a line of demarkation between impression and cast, and impart a smooth surface to the cast, will answer the purpose.

A coating, first, of shellac varnish and then of sandarac varnish probably gives the best results. Collodion, colored with potassium permanganate, or an indelible lead pencil, also gives good results. Thin oils and soap are used also, but do not make a line of demarkation, nor insure a smooth surface to the cast, both of which are important considerations. Many commercial separating fluids are prepared and answer the purposes satisfactorily.

At this point every detail that will insure strength in the cast should be observed. A precaution which will insure a maximum of strength in the reproduction of the teeth, and particularly where teeth stand alone and are unsupported, may be observed by placing an ordinary pin, point downward, into the mold of such teeth in the impression. (Fig. 22.) Thus strengthened, it is seldom that teeth break off and greater accuracy results.

Pouring the Cast. When the impression has been prepared, it should be dipped in water and poured.

Fig. 22.

A good grade of "cast" plaster should be used in making all casts that are not to be subjected to the heat of soldering.

Where great indestructibility and the minimum change of form are demanded, the magnesium oxid compounds and a compound known commercially as "metcom" are useful.

But in all cases where soldering is to be done directly on the cast, the cast must be made of some high-grade investment compound. These compounds withstand heat far in excess of plaster, which is disintegrated at a temperature much lower than that required for soldering.

Separating Cast from Impression. It has been suggested that the body of the impression usually should cling to and be removed with the impression tray. This is to be insured by notching or indenting the edges of the tray, or by attaching a rim of wax securely to the edges, or both.

Because of this precaution, care must be exercised in separating; first, to remove the tray without endangering the cast; and, second, to trim the impression slowly and carefully to a point which discloses the line of demarkation made by the varnish. The remaining thin portions may then be removed cautiously without defacing the cast or breaking off the teeth.

Self-separating Plaster. A self-separating plaster compound commercially known as "complaster" is also used for impressions, and is useful for many purposes. This compound is manipulated like ordinary plaster. In its use the impression is separated from the cast by placing it in tepid water and then increasing the temperature, gradually, until the boiling point is reached. It should then be boiled until the "complaster" impression is dissolved entirely. If liquid silex is used as a separating varnish a cast having smooth and definite surface outlines results.

Impression Compounds. The use of impression compound, commercially called "modeling compound," for impressions for crown and bridgework is not recommended. It is a material which provides an easy means at the expense of accuracy.

Any material, like impression compound, which remains more or less plastic at body temperature, or which will pull or draw in removing, is entirely inadequate to the requirements of accuracy. Even the most difficult or complex case would offer no excuse for its use. Indeed it is in such cases that a degree of accuracy far beyond the possibilities of compound, or of similar materials, is demanded.

Taking the Bite.

The procedure which has to do with obtaining and transferring the correct occluding relationship of the opposing teeth, and which, for the want of a better term, perhaps, is referred to as "taking the bite," is second in importance only to the impression.

It is a procedure always replete with uncertainty and one which demands close observation and painstaking care if accuracy is to be insured.

Whenever any parts of the work under construction are to be transferred to the cast by means of the impression, the "taking of the bite" must precede the taking of the impression. This becomes necessary because the parts which are to be removed with the impression must be in place when the "bite" is taken in order that the "bite" may be adjusted correctly to the cast with the parts in place thereon.

Pink base plate wax is the best material for the purpose. The "bite" should include all adjacent remaining natural teeth and should afford a good, deep imprint of the opposing teeth. Every precaution must be taken to insure a correct reproduction of the occlusal relationship of the opposing teeth.

The requirements of accuracy also demand the exercise of care in the

adjustment of the wax "bite" to the cast, and in filling completely the imprints of the opposing teeth in mounting the case upon the articulator.

For this purpose a good, hard plaster should be used because a maximum degree of indestructibility of the opposing teeth, when mounted upon the articulator, will facilitate and insure a more accurate occlusion.

In instances where these requirements are specially exacting, greater accuracy will result from filling the imprints of the opposing teeth in the wax bite with any of the so-called "artificial stone" compounds. And even amalgam often may be used for this purpose to advantage. The time required for hardening or for crystallization will be compensated for through greater indestructibility and increased accuracy.

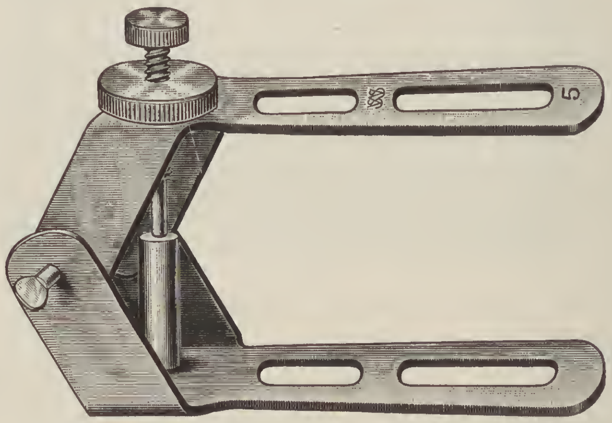


FIG. 23.

Articulators.

No form of articulator now used will meet all of the requirements of articulation and occlusion satisfactorily.

The requirements of accuracy in reproducing functional occlusion in crown and bridgework are to be obtained best from the use of some type of "anatomical" articulator in all cases.

An approximate reproduction of lateral mandibular movements is almost as essential in crown and bridgework as it is in denture construction. For single crowns and small bridges, however, a simple form of crown and bridge articulator (Fig. 23) may answer the purpose.

CHAPTER VI.

INVESTMENT AND INVESTMENT COMPOUNDS.

In crown and bridgework the finished product, whether it be small or large, simple or complex, presents as a single unit, or as one or more interrelated single units. But, just as the mass is composed of atoms or molecules, and tissues are made up of cells, this finished product in the composite is made up of an assemblage of several or many basic units.

In the technical details of construction, the assemblage of these basic units must be made with every possible degree of certainty and accuracy. And certainty and accuracy obtain only by observing some means of temporarily sustaining the desired relationship of these units until their permanent assemblage may be effected.

To sustain this relationship in a secure and dependable manner and otherwise to protect each and every single unit as the requirements may demand is the purpose of the investment.

Purpose of Investment. The combined purposes of the investment, therefore, are, first, to sustain the correct relationship of all of the single units of which the piece is to be composed while they are being assembled permanently; and, second, to protect any and all parts which require, or demand, protection by the more or less equal distribution of heat during the process of assemblage.

All metals and all minerals expand and contract under the influence of heat and cold. And in exact ratio to the control of this expansion and contraction by the gradual and uniform distribution of heat, will the resulting molecular changes be harmful or harmless.

The physical properties of the metals are so entirely different from the physical properties of the minerals that special care must be exercised whenever both are to be used in the same combination, and are to be subjected to the influence of excessive heat at the same time.

Porcelain absorbs and gives off heat so slowly in comparison with gold that whenever porcelain teeth or facings are to be assembled in combination with gold or platinum, which is frequently necessary, they must be protected against the possibilities of being heated too rapidly, cooled too

rapidly, or too sudden expansion or too sudden contraction. The investment affords this protection.

Preliminary Requirements. Previous to their investment, the relationship of all units to be assembled must be securely sustained, first, with hard wax. When this has been done, the surfaces of all metal to which solder is to become attached, upon which it is to flow and with which it is to become alloyed, should be covered with wax. This precaution is necessary in order to keep these surfaces clean, uncovered and freely exposed in the investment, after the wax has been removed, either by burning out or with boiling water.

A special "hard" wax, made hard by the incorporation of resin, is prepared for the purposes of crown and bridgework by the manufacturers of dental supplies and always should be used in this work.

Requirements of Investment. Where the cast has been made of investment compound and it is desired to assemble the parts, under construction, without removing them from the cast, first submerge or dip the cast in water of normal temperature and then apply the investment compound. This should be mixed to a proper consistency and in sufficient proportions to sustain securely the relationship of all parts, and to insure their necessary protection during the application and under the influence of the required heat.

As all reliable investment compounds necessarily are composed of refractory and more or less infusible ingredients, it follows that they are also poor conductors of heat.

The completed investment, therefore, never should be larger in size than sufficient to insure adequate strength. The larger the investment, the more heat required in the assemblage of the parts. Hence, when the added quotient has become thoroughly crystallized, all unnecessary surplus above and beyond the actual requirements should be trimmed away as a means of economizing, both in length of time and degree of heat.

Removing Parts from Cast. Whenever it is desirable to preserve the cast for further use, or whenever the cast may have been made of plaster, instead of investment compound, the parts to be assembled must be transferred to a separate investment.

While not quite so reliable, this procedure may be accomplished safely, first, by detaching carefully all parts fixed in their positions on the cast in such manner as will admit of their accurate replacement.

When thus detached and replaced, the desired relationship of all parts to be assembled should be sustained securely with hard wax. The whole then should be removed from the cast and invested separately.

The single units may be detached from the cast in an easy and accurate manner, and mutilation of the cast prevented, by painting the surfaces of the exposed parts in the impression, before pouring the cast, using melted wax applied with a small brush. When this precaution is taken, all parts so treated may be detached easily from the cast by heating slightly, after which they may be cleaned in the acid bath and replaced accurately.

In the investment of parts which have been thus detached and replaced, attention should be directed to filling them completely with investment compound. If not well filled, air spaces may result, inviting the accumulation of heat and endangering the fusing of such parts during the soldering process.

Whenever a more than ordinarily smooth cast of investment compound is desired, a well-defined surface detail is to be obtained by first filling the impression with a thin mix of cast plaster; then inverting the impression until only a thin surface coating remains, when it is poured immediately with investment compound. The resultant cast will possess all of the advantages demanded by the requirements of accuracy and of heat-withstanding properties.

Removing Wax. When the investment has become thoroughly crystallized and has been trimmed to the desired form and size, the wax should be removed by pouring boiling water over it. All thin, overhanging edges of investment should be trimmed away carefully, the parts to be assembled properly fluxed, the cast placed over a flame, and heated gradually.

Requirements of Investment Compounds.

Good, reliable investment compounds, adapted to the requirements of crown and bridgework, must possess the following physical properties:

First: They must withstand heat successfully.

Second: They must offer a minimum of expansion and contraction properties.

Third: They must be strong inherently.

Heat. The property of withstanding excessive heat is essential because the investment compound is to be subjected to a degree always equal to the fusing point of the solders used in the final assemblage of the parts.

To possess this property the compound necessarily must be composed largely of such refractory and infusible ingredients as will not be subject to any appreciable change under the influence of the required heat. Compounds which will subscribe to these requirements are necessarily poor

conductors of heat, but where such an excessive degree of heat is required, conductivity is a negative factor.

Shrinkage and Expansion. A minimum of non-shrinkage and non-expansion properties is important because all of the accuracy to be obtained in preserving the relationship of the parts to be assembled depends entirely upon, and is insured only in proportion to the degree to which these properties are possessed by the compound.

Strength. The element of inherent strength is an important requirement of all investment compounds, and must obtain in order that the investment may retain its given form, and support and sustain the various physical changes which take place in the process of heating, soldering and cooling.

Character of Investment Compounds. Two general classes of investment compounds are used, each possessing different physical properties and characteristics, and each useful for the respective purposes for which it is intended.

These classes of compounds are: First, those that possess the physical property of crystallization at normal temperature; and, second, those which do not crystallize and are used in a semiplastic state and which are hardened subsequently by burning or heating.

Crystallizing Compounds. An investment compound that crystallizes without heating offers the greatest field of usefulness, and is adapted more universally to all classes of work. Its use is indicated generally for the purpose of obtaining casts from plaster impressions where inherent strength is necessary. It is used also for all other purposes where a definite form is to be given to and must be maintained by the investment.

The property of crystallization, however, is obtained by the incorporation of plaster of paris with the other more refractory and infusible ingredients. And as plaster of paris will not withstand heat, and is disintegrated at a very low temperature, it is used only as a binder and as a means of imparting the property of crystallization to the compound. Beyond this, the incorporation of plaster of paris is harmful and its presence subtracts from the desired physical properties of these compounds in all other directions.

Non-crystallizing Compounds. That class of compounds known as non-crystallizing compounds do not contain plaster of paris. They are used in the semiplastic state and are hardened by burning or heating.

These compounds, under the influence of heat, shrink and expand to a lesser degree than those which contain plaster of paris and crystallize.

Their use, therefore, whenever indicated insures a maximum of accuracy in the assemblage. Their field of usefulness is confined to the assemblage of such units as may be held in proper relationship with hard wax, invested in a semiplastic mix of the compound, and then placed immediately over a flame, and heated with a slowly increasing temperature, the wax being burned out simultaneously. A fine wire mesh is useful as a means of sustaining the investment while heating and soldering.

Drying and Heating. The drying and heating of an investment is important. Both classes of compounds contain water of crystallization and this must be evaporated or driven off slowly and gradually. The investment should, therefore, be placed over a low flame at first, and the heat increased slowly until thoroughly dry, after which the temperature may be raised more rapidly until the case is well heated and ready for soldering.

CHAPTER VII.

SOLDERING.

Soldering is an art. It is an art that requires special skill, and an art that presents a fertile field for the acquirement and development of skill in many lines of effort.

Metallurgy teaches that soldering is the physical process of uniting metals by the superficial alloying of one with another. Or, the process of uniting metals by the fusion of one to another, one being slightly more fusible than the other.

Whether this process be executed by the itinerant tinsmith in the simple act of mending his wares, by the modern plumber in the more difficult feat of "wiping a joint," by the expert gold and platinum smiths in their highly artistic lines of work, or by the skilful dentist in his particular field of effort, the process of soldering is always an interesting procedure.

The special field of crown and bridgework offers almost unlimited opportunities and possibilities for the acquirement, development and display of skill in the art of soldering. And versatility in skilful attainments along these lines must include this art, because skill in designing and skill in effecting accuracy of adaptation are evidences of wasted effort and energy only, unless they be combined with skill in assembling; for without skill in assembling, the finished product is faulty.

But soldering is not the work of an automaton. Nor may its highest possibilities as an art ever be reached if it is attempted in a perfunctory manner. Once the lesson has been learned, however, the technical details of procedure are simplified and soldering becomes easy.

To this end the dentist cannot apply himself, or herself, too closely in an effort to learn the lesson, thus to become, if not expert, at least sufficiently skilled, to render the procedure one of simplicity and ease, thereby reducing to a minimum all attending dangers and eliminating entirely all possibilities of failure.

These possibilities will result from and follow a broad and comprehensive knowledge of the basic requirements, and a careful observation of all essential details fundamental to success.

Basic Requirements.

The basic requirements which must be observed are as follows:

First: Freedom from oxidation.

Second: Apposition of surfaces to be united.

Third: Proper application and distribution of heat.

Fourth: Use and proper application of flux·

Freedom from Oxidation. The first essential requirement is that of freedom from or removal of oxidation. As all metals oxidize under the influence of heat, and as solder will not attach to nor alloy with an oxidized surface, all surfaces of metal to be united, or upon which solder is to flow, must be clean and free from oxidation.

And this applies also to the surfaces of the solder itself, because solder is even more susceptible to oxidation, for the reason that it contains a greater proportion of base metals as an alloy, and base metals oxidize more readily than do the noble metals.

It is apparent, therefore, that all surfaces of the metals to be united, and of the solder which is to unite them, should be perfectly clean and free from oxidation at all times during the process of soldering.

This cleanliness of surfaces and this removal of oxidation may be effected either by scraping or filing, or by immersing in the acid bath.

Acid Bath. The acid bath is the quickest and most effective way of removing oxidation and all traces of extraneous and foreign matter from the surfaces of metal.

For this purpose hydrochloric or sulphuric acid, diluted with equal parts of water, is used. Hydrochloric acid is preferable, because it is a better solvent of the silicates and of the flux used in soldering. It should be kept in a suitable container, such as the ordinary procelain evaporating or Petri dish, having a lid or cover.

For the simple soldering of bands and all small pieces where no investment is used, the parts may be cleaned effectively by heating them to a cherry-red and then plunging them into the acid bath at normal temperature.

But if heating directly in the flame is not indicated because of the size of the piece, or because of the presence of porcelain teeth or facings, it is necessary to place the bath containing the work over the flame and to allow it to simmer or, perhaps, even to boil until the parts are thoroughly clean.

Precautions. When thus properly cleaned, all traces of acid should be removed immediately by immersing in a solution of sodium bicarbonate,

followed by the copious application of water. If this precaution be not taken and the parts again be subjected to heat while any traces of acid remain upon their surfaces, the salts of the baser metals will be precipitated and any subsequent soldering made exceedingly difficult, if not prevented entirely.

Apposition. As a means of facilitating their union, apposition of, or close contact between, all surfaces to be united should obtain always.

Solder may be made to flow over clean, properly fluxed surfaces, and sometimes to flow uphill or against gravity, but it balks at jumping over a space.

Therefore, when the desired relationship between the parts to be united will not admit of direct apposition, or of close contact between them, any existing space should be filled in with small pieces of wire, or plate, closely fitted in such manner as to fill the space and restore apposition.

These supplementary pieces thus fitted into spaces over which solder is to flow are called "Dutchmen" by the manufacturing jeweler, and their use will facilitate the soldering process.

Application and Distribution of Heat. The proper application and distribution of heat is a consideration of the greatest importance in soldering. Because of a failure to recognize, appreciate and observe the requirements in this regard, much discouragement often follows, and much unnecessary and useless effort is often expended.

To insure successful results, it must be remembered that soldering is the process of alloying. And, to make alloying possible, all surfaces to be alloyed must be exposed freely, to be adequately and uniformly heated. Also, it follows that these surfaces must be heated to a temperature slightly exceeding, or at least equal to, the degree of heat required to fuse the solder, before the solder will unite or alloy with the metal.

This means that the case to be soldered, whether it is invested or not, must be properly, uniformly and adequately heated over the flame, or with the blowpipe, or both, before any effort is made to flow the solder.

If this requirement of heat is observed properly, and then if the parts are fluxed properly, the process of soldering is made simple.

Use and Proper Application of Flux. Attention has been directed previously to the oxidation of metals under the influence of heat, and to the necessity of removing, reducing, in so far as possible, and preventing their oxidation in the process of soldering. What is known as a "flux" is used for this purpose.

The flux, fusing at a low temperature, protects the surfaces to be

soldered from oxidation by fusing over and upon them, and, by thus keeping them clean, the process of alloying, or soldering, is aided and made possible.

It is equally necessary, also, that each piece of solder to be used should be treated similarly, for, being a lower grade of alloy, it is oxidized more easily. And when the solder is not so treated, the oversight frequently might cause much obstinacy in fusing, and demand a greater degree of heat than otherwise would be required.

Borax. Borax is used generally for this purpose and meets all requirements. It should be made into a thick, creamy paste and applied

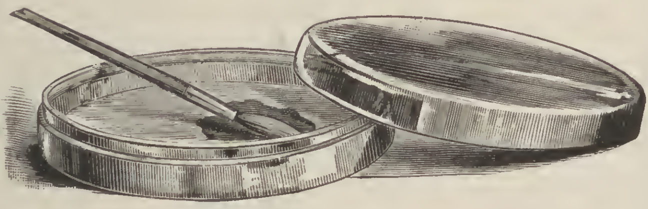


FIG. 24.

to all surfaces upon which solder is to become attached before they are heated. A convenient container and a brush of proper size are illustrated in Fig. 24.

The use of dry, powdered borax is objectionable, and the use of a greater quantity than necessary should be avoided. Either is dangerous in invested cases because when first heated it expands to such extent as to endanger the integrity of the investment and the relationship of the parts.

Liquid Flux. Liquid flux, which is a saturated solution of equal parts of borax and boric acid in water, is a convenient form of flux for soldering simple bands and small pieces, where no investment is required.

Technic of Soldering.

Fortified with a knowledge of the basic requirements, the lesson of soldering, as it applies to crown and bridgework, may be learned by a careful observation of the various technical procedures involved.

Soldering Without an Investment. The simplest form of soldering presents when the proper or desired relationship between the surfaces or parts to be united may be sustained during the process of soldering without resorting to an investment.

Soldering without an investment is accomplished much more easily than when an investment is used, because less heat is required; and its application may be made more directly and may be distributed more uniformly.

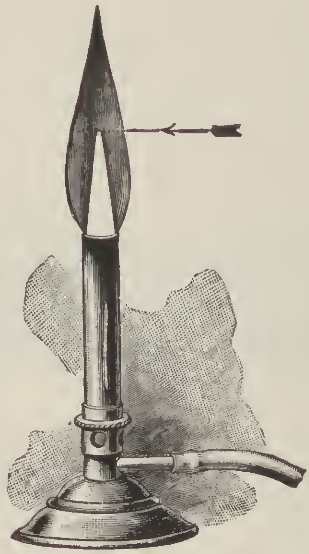


Fig. 25.

Fig. 26.

The simple soldering of bands, copings, dowels, or any and all other parts requiring no investment may be done directly over the flame and often without the use of the blowpipe.

In soldering directly in a flame, however, it is necessary to know something about the varying degrees of intensity of heat developed by a flame. The Bunsen burner will be used, for example, though the flame of an alcohol burner—from the viewpoint of the flame itself—is the same. Small pieces of work may be soldered in an alcohol flame, but a Bunsen burner, because of affording a greater volume and a more concentrated intensity is more generally useful.

Flame. The flame of a Bunsen burner consists of an outer sheath, varying in color from a dark blue at the base to a yellowish white at the point. This outer sheath envel-

ops a central cone of light-bluish color; at the apex of this central cone is the greatest degree of heat. (Fig. 25.)

Hence, all parts to be soldered should be carried to a point in the flame immediately over the apex of this central cone. The work should be grasped firmly with small pointed pliers at a point on its surface which is removed as far as possible from the immediate point of soldering. This precaution is necessary, for the pliers will absorb heat, and the closer they are to the point of soldering the greater will be the heat required. Steel pliers are used generally for this purpose. (Fig. 26.) Nickel pliers, however, would be better, for nickel would not absorb the heat so readily as it is a poorer conductor than steel.

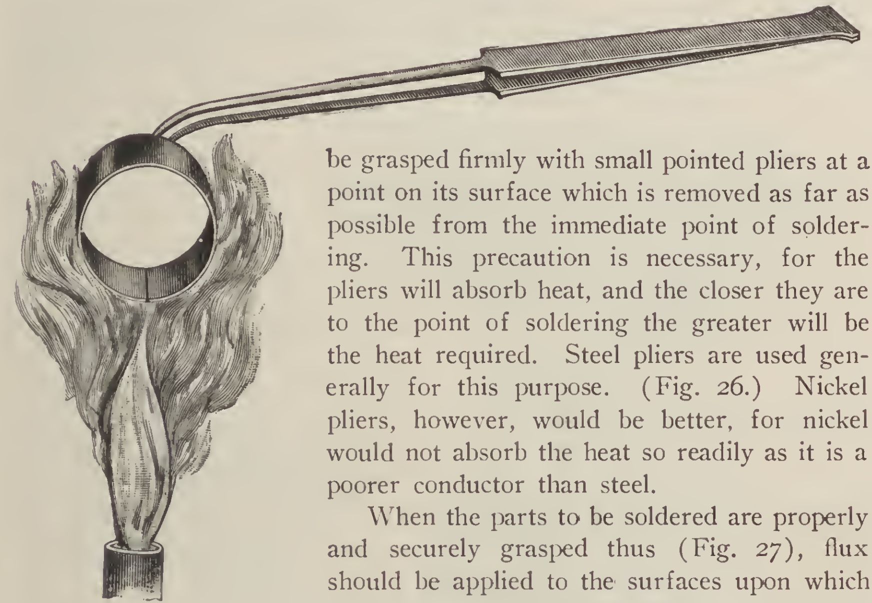


Fig. 27.

When the parts to be soldered are properly and securely grasped thus (Fig. 27), flux should be applied to the surfaces upon which the solder is to flow, carried to the flame and fused; and the solder, also fluxed properly, is then placed in position so as to be in contact with the immediate surfaces to be united, and then fused. Care must be exercised to remove the work from the flame as soon as the solder flows, because, the object being accomplished, any additional heat beyond this requirement would only invite the fusing of the parts themselves.

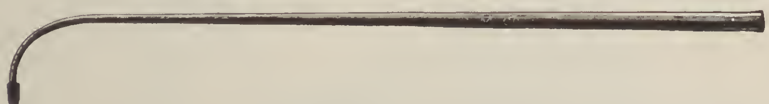


Fig. 28.

Mouth Blowpipe. As a rule, a simple mouth blowpipe, such as is used commonly by jewelers (Fig. 28), will answer all purposes, and the soldering frequently may be accomplished by means of the flame alone and without the aid of any form of blowpipe. A small bench blowpipe

used in combination with compressed air is useful, especially because it gives the operator free use of both hands.

Soldering with an Investment. Whenever an investment is required as a means of sustaining the relation of the parts, the process of soldering, necessarily, is more difficult and the requirements more exacting, but more difficult and more exacting only because greater heat will be required: and greater heat is made necessary only because of the

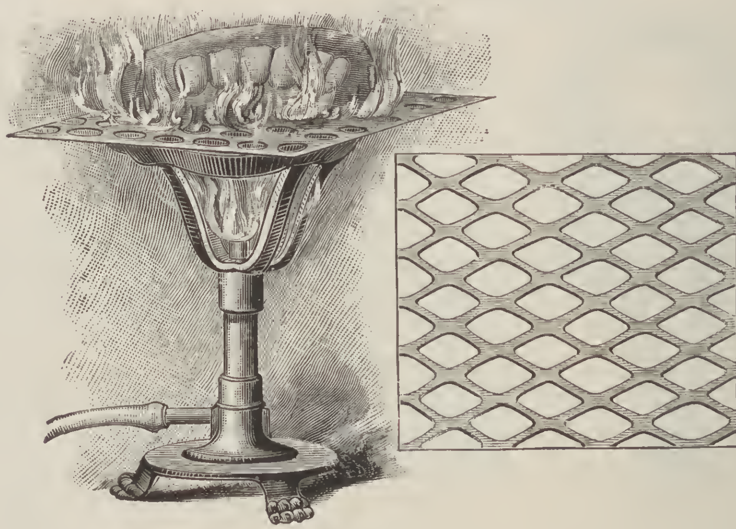


FIG. 29.

presence of the investment, which must also and always be heated adequately before any attempt is made to flow the solder.

Therefore, when the invested case is trimmed properly, fluxed properly and otherwise is ready for soldering, it should be placed on a soldering mesh, over a good-sized flame (Fig. 29), and allowed to remain until heated thoroughly throughout. And the more thoroughly the case is heated before attempting to solder, the easier will be the process of soldering. And, further, the larger the case, and the larger the investment, the more heat and the more time will be required.

When the case is heated properly, thus, over the flame, it is ready then for the blowpipe.

Combination Blowpipe. What is known commonly as the "combination" blowpipe is used in all cases requiring any very great degree of heat, and always when an investment is necessary. (Fig. 30.)

The combination blowpipe, used with illuminating gas, may be operated by means of the mouth, bellows, or compressed air, at the pleasure and convenience of the operator. In the absence of illuminating gas, various

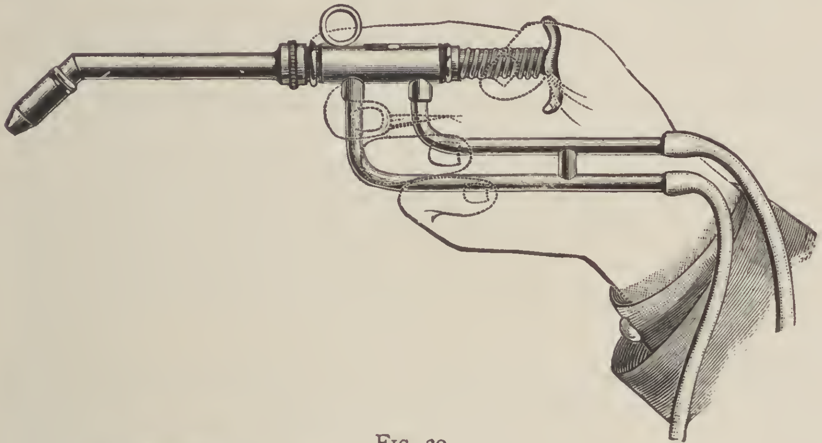


FIG. 30.

FIG. 31.

forms of gasoline blowpipes, operated by means of the bellows, may be used. (Fig. 31.)

Management of Solder. The solder to be used should be cut into pieces as large as may be convenient, well fluxed, placed in position on the

surfaces to be soldered, and a moderate-sized, pointed flame from the blowpipe then directed upon the whole. A large or "brush" flame from the blowpipe is useful only for the purpose of primary heating.

In fusing the solder, a small, pointed flame from the blowpipe should be directed over and upon both the parts to be united and the solder; and it must be remembered, that all surfaces upon which the solder is to flow must be heated first to a degree equal to the fusing point of the solder before the solder will flow smoothly upon or attach itself to them.

As the solder begins to fuse and flow nicely, the flame from the burner underneath may be reduced in volume and the flame from the blowpipe directed upon the parts and continued until all of the solder, which the requirements of strength and contour demand, has been added and fused properly.

Balling Up of Solder. Whenever the solder will not behave thus, when it will not flow smoothly and attach itself without trouble, or whenever it persists doggedly in fusing within itself and assuming globular form, or shaping itself into spheroids, which is commonly termed, "balling up"—positive evidence is presented that the parts to be soldered are not yet uniformly and adequately heated.

Effect of Gravity. In soldering large cases, and particularly if they involve the anterior teeth where the curvature is great, it is frequently necessary to change the position of the investment as the process of soldering progresses. This change is necessary as a means of observing the law of gravity and of retaining the solder at the desired point while it is yet in the fluid state. This feature should be observed to a greater or lesser extent in all cases.

Soldering Porcelain Facings. Porcelain facings rarely, if ever, should be subjected to the heat of soldering. This statement does not imply that porcelain facings which have pins made of platinum, or of any of the precious metals baked in them, should not be used. But it does mean that when they are used they should be attached to their supporting structure by cementation, or other means which will not require that they be soldered. Soldering, at best, always weakens porcelain facings, and the process of soldering invites the possibility of fracturing them.

This possibility is due to the very marked difference in the physical properties of the porcelain on the one hand, and of the metal pins on the other hand. Porcelain absorbs heat slowly and gives it off slowly, while the metal pins absorb heat rapidly and give it off rapidly.

Hence, in soldering porcelain facings, the utmost care must be exer-

cised in applying heat in such manner as to insure the expansion of the porcelain previous to, or at least simultaneously with, the expansion of the pins. This is necessary in order that the porcelain may be able to receive and accommodate the expansion of the pins. Otherwise, uneven expansion will occur and the facing, being a friable substance, may be fractured thereby.

The same precautions must be observed in cooling after soldering, and for the same reasons. Therefore, when porcelain facings are to be soldered, the investment should be heated slowly and the temperature raised gradually; and when the soldering has been completed the same care in cooling must be observed.

It is necessary to note, also, that no overhanging edges of backing are permitted to remain in contact with porcelain facings which are to be soldered. The shrinkage of the solder in cooling, irrespective of the care given, invariably will cause a degree of impingement upon the porcelain which will result in fracture and which can be overcome only by avoiding overhanging edges.

Soldering Gum Block Teeth. If single porcelain facings having metal pins baked in them should be subjected rarely, if ever, to the heat of soldering, it is equally certain that gum block teeth having similar pins, should almost never be soldered.

And yet their use may be indicated, in very rare instances, where the piece must restore excessive absorption, and where the best result from an esthetic point of view may result only by using gum block teeth.

Gum block teeth may be soldered successfully, by backing separately each tooth contained in the block, and by not having contact between these separate backings. This precaution will assist in accommodating shrinkage, and thus provide against fracture.

Shrinkage of Solder. The shrinkage of solder is an element which cannot be overcome. It cannot even be reduced, but it can be guarded against. All solders shrink more than do the basic metals, because they contain a low-fusing, base metal alloy.

To guard against any possible change in the relation of the parts to be assembled by soldering, it should be observed: First, that the parts are in close apposition; and, second, that only a minimum of solder should be fused, or be carried to the fluid state at any one time.

In work having several units to be assembled, therefore, the units should be assembled in small sections first, using a solder of a higher grade than that which is to be used in the final assemblage. By this means, when the sections are assembled finally into one piece, the quantity

of solder required to effect the assemblage and which must be brought to the fluid state at this time will be reduced, and the dangers from shrinkage lessened correspondingly.

Cooling After Soldering. When the process of soldering has been completed, the heat should be reduced slowly in order to avoid too rapid contraction. When the temperature will permit handling, the investment should be broken away and the case subjected to the acid bath. To cool slowly is particularly necessary where porcelain is used.

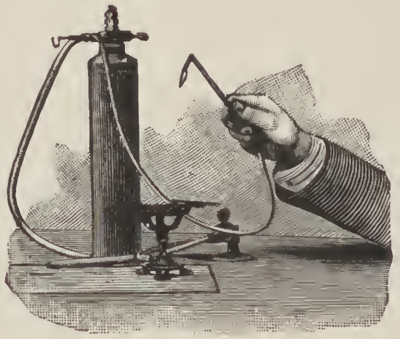


Fig. 32.

Pure Gold as a Solder. In the use of pure gold as a solder for platinum, very little flux is required, because the degree of fineness of both metals decreases the tendency to oxidation. Pure gold does not fuse and flow so easily nor so readily as solder, however, and, therefore, greater heat is required·

If no investment, or merely a very small one, is necessary, pure gold may be fused with the combination gas or gasoline blowpipe and the bellows, or compressed air; or, with the oxyhydrogen flame. But, whatever may be the source of heat production, the gold must be thoroughly fused and practically alloyed with the platinum if any degree of strength in the union of the parts is required, and is to obtain. Hence the platinum must be brought to a very high degree of heat and this heat must be maintained during the flowing of the gold used as a solder.

Platinum Solder. For all forms of platinum work, where any great degree of strength in the soldering is required, or where a greater degree of infusibility is demanded, both may be obtained by the use of platinum solder.

Platinum solders, varying from ten per cent. to twenty-five per cent. of platinum in pure gold, are made for such purposes. These solders

are to be fused successfully only by means of the oxyhydrogen blowpipe. Hence, no advantage is obtained by using less than twenty-five per cent and this alloy should be the standard platinum solder.

Oxyhydrogen Blowpipe. For all forms of soldering where either pure gold or platinum solder is used, a more intense and more concentrated flame than is afforded by the combination gas and air blowpipe is required.

Nitrous oxid gas in combination with illuminating gas produces a flame of great heat intensity. This is known as the oxyhydrogen flame. An oxyhydrogen blowpipe is a simple, inexpensive and quite necessary part of the equipment for doing soldering of this character. A simple form of blowpipe is illustrated in Fig. 32.

A proper manipulation of the oxyhydrogen blowpipe involves the problem of obtaining perfect combustion.

Sweating Method of Soldering. In soldering, the process known as "sweating" is often useful. "Sweating" solder means that the solder is fused only partially; or, that it is fused only until it alloys with or attaches itself to the metal, without being brought to the fluid state.

This procedure is useful in many kinds of repair work where contact of the parts to be united does not present, or in covering up or filling in pits, holes and perforations. And, also, in instances where the complete fusing of the solder might endanger the relationship existing between the parts by the fusing of the parts, or the refusing of the solder used previously.

In "sweating" solder, every requirement of soldering should be observed, except that of bringing the solder to the fluid state.

To Prevent Unsoldering. Some means of preventing the refusing of solder previously used is often a very desirable, and even necessary, precaution to be observed.

This may be accomplished by painting any surfaces of metal or solder with an anti-flux, such as a paste of precipitated chalk, whiting, plumbago, or crocus, before heating. By this means the refusing of solder previously used is prevented, and any danger of destroying the existing relationship of parts is thus largely, if not entirely, overcome.

Base Metal Contamination. In using gold and platinum alloys of any kind, and particularly when they are to be subjected to the heat of annealing or of soldering, care should be exercised at all times to prevent any possibility of contamination by base metals.

The presence of any of the lower fusing base metals in contact with gold or platinum, when heated, endangers the fusing of these metals

and destroys their integrity. Contact with mercury, which is absorbed rapidly, is dangerous also, and should be avoided.

Any contaminating influence of the base metals may be overcome if they are removed by boiling in acid before heating, either in the flame or with the blowpipe.

Autogenous Solder. Autogenous soldering is the process of uniting surfaces of metal by immediate interfusion, without the use of a lower grade or more fusible alloy. The procedure offers no advantage, except that a joint made in this manner is not increased in stiffness or thickness.

In executing the process of autogenous soldering, the surfaces, or edges, to be united, must be retained in close apposition, must be fluxed properly, and then heated carefully until superficial fusion unites them.

The dangers are greater than are the advantages thus to be obtained.

Liquid Gold Solder. A solution of gold known commercially as "liquid gold" solder may be used in soldering platinum, and all karats of gold. In its use the surfaces to be united must be placed, and held, in close contact. The liquid solder is then painted on with a brush and fused over a Bunsen burner. No flux is necessary.

The use of liquid solder would be a means of facilitating autogenous soldering, but otherwise no advantage obtains.

Soft Soldering. Soft soldering means the uniting of parts or surfaces with a low-fusing, base metal alloy called "soft" solder. Except for emergency or temporary work, "soft" soldering is seldom indicated in dental work. The alloy used most commonly for soft soldering is composed of equal parts of tin and lead, though any of the fusible alloys will answer the purpose. Zinc chlorid is the flux.

The necessary heat is applied usually with a soldering iron, or a small alcohol or Bunsen flame may be used.

Application of Electricity. The wonderful advancements made in the application of electricity to heat-producing purposes makes it reasonable to expect that this clean and refined method of heat production will eventually be applied successfully to both soldering and casting.

CHAPTER VIII.

CASTING.

Casting is also an art. History teaches that the casting of metals was an ancient art, but its application to dentistry is modern.

With the advent of the application of the casting process to dentistry, former methods of practice were revolutionized; text-books were re-written, and results more certain and more definite were made possible and more easily accomplished.

And, yet, the casting process is not necessarily a method which affords only the "easiest way," nor is it a lazy man's method. Its successful application to the field of crown and bridgework demands all of the painstaking care, all of the close and keen observation of minute detail, all of the talent and all of the skill that is required in the successful application of any combined artistic and mechanical procedure.

The application of the casting process involves making the original pattern in wax and reproducing the original wax pattern in metal.

Wax is a plastic and easily manipulated substance, but since the reproduction in metal can never be more perfect nor more accurate than was the original wax pattern, it is apparent that quite as much skill must be displayed in making the wax pattern as will be demanded in the application of the process by which its reproduction is insured.

Records show that ancient and primitive efforts in casting metals embraced the wax pattern; the investment of this pattern; the burning out or the disappearance of the wax by the application of heat; and the resultant mold in one single unit. But these efforts were directed along purely artistic lines. The designs and the castings made were for artistic and ornamental purposes only, and were not made with any idea of fitting anything.

The possibilities of making these castings to fit something, or of obtaining accuracy of adaptation in casting probably were not even conceived. At least, it is not recorded in the early history of casting that any effort was made to combine the possibilities of making the pattern in wax and reproducing it in metal, with the result of obtaining a casting of definite form which would fit accurately to something possessing a given and definite shape.

The conception of the idea of making a wax pattern in a mold of definite form and shape, and then of reproducing it in metal by the casting process, and of reproducing it in such a manner and with such accuracy as to have the reproduction fit the original mold, or its replica, was responsible first for the introduction of the application of the casting process to dentistry.

An immediate recognition of the advantages obtainable inspired the development of a technic which would insure success in its application.

And, as a result of this inspiration and of the original development of a successful technic by Dr. William H. Taggart, the casting process is recognized now as being generally applicable to an almost unlimited field of usefulness in dentistry. It is indeed the very foundation of modern successful achievements in crown and bridgework.

The Casting Process.

The advantages offered by the application of the casting process to crown and bridgework, using former methods of procedure as a basis of comparison, may be enumerated as follows:

First: Accuracy of adaptation.

Second: Increased opportunities for obtaining desired form and contour.

Third: The use of alloys of higher grade or better quality.

Fourth: Simplicity and definiteness of technic.

Application. The casting process may be applied to almost any of the methods of construction in crown and bridgework. It is applicable equally to the simplest type of crown, or the simplest form of attachment for bridgework; or to the most extensive and complex requirements of bridgework, either of fixed or removable type.

Its field of usefulness practically is unlimited, and its range of successful application is limited only by the acquirement of the necessary skill, and the development of a technic which will preclude failure and insure success. And these will accrue from the practice of observing all of the most minute details most carefully, and from an effort to standardize the technical details of procedure involved.

Technic. A technic which will insure success in casting cannot be standardized and made applicable to all alike. The personal equation enters into the execution of all mechanical pursuits so largely that it renders any effort toward this end impracticable.

But a study of the basic principles, and a strict adherence to the

basic principles will aid very materially in the development of an individual technic that will be successful in the hands of the person who develops it.

During the acquirement of a successful technic by any one, failure must be expected at times, and the only way to avoid failure is to profit by it. Study the cause of the failure and eliminate the possibility of a recurrence due to the same cause.

The primary consideration, essentially, is a knowledge of the requirements of the wax pattern and of the methods by which the pattern may be secured in the best manner. Two methods of procedure are in vogue. These are known as the *direct* method and the *indirect* method, and each has its respective field of usefulness.

Direct Method. The method known as the direct method is that in which the wax pattern is made directly into or upon the natural tooth, or root, in the mouth.

For the reason that no reproduction is ever as accurate as the original, the direct method affords some advantages. But the direct method is limited in its application, and is successful only in single units, such as inlays, and in some forms of partial or full crowns.

When the opportunities present for obtaining the required accuracy of adaptation directly in the mouth, and when they present with every assurance of success, the direct method is indicated.

In its application, the pattern always should be made with a wax sufficiently hard to withstand the influence of body temperature. This is essential in order that the pattern may be handled in the fingers without danger of warping or distortion. Any wax which is adapted to this purpose is to be heated best and most uniformly in hot water.

Indirect Method. The indirect method is the method universally used in crown and bridgework, and that by which the best results are to be obtained. This method is indicated in all cases where the pattern which is to be made involves more than a simple, single unit.

The indirect method requires: First, a good, accurate impression; and, second, a good, accurate cast.

Impression Compound Impressions. In all cases where only a single unit is involved, the best, smoothest and most reliable impression is to be obtained by the use of a hard grade of impression compound which is prepared in stick form specially for this purpose. This special compound should be used in conjunction with a small seamless band, which has been adapted previously and properly to the requirements of the case. (Fig. 33.)

Amalgam Casts. The most accurate, reliable and indestructible cast may be obtained by filling this compound impression with a good, quick-setting amalgam alloy. To obtain such a cast the excess compound should be cut away from the copper band, and the band with the impression should be invested in plaster of paris in such manner as to form a matrix for the amalgam. The impression is pressed down into the plaster so as to afford extra height to the amalgam cast. (Fig. 34.) When so invested a good grade of quick-setting amalgam alloy should be mixed properly

FIG. 33.

and packed carefully into the impression, completely filling the mold formed by the impression and the surrounding plaster.

When the amalgam has crystallized, the plaster matrix should be broken away, and the amalgam cast and compound impression placed in hot water until the compound is softened sufficiently to admit of its easy removal from the cast.

If the compound impression has been taken with sufficient care to be accurate and with sufficient care to possess smooth and definite outlines, the resulting amalgam cast will require no finishing. Any surplus of amalgam, however, which might interfere with a free exposure of the outlines of the surfaces and margins to which the adaptation is to be made, may be removed with stones or disks. (Fig. 35.)

Indications. A cast made of amalgam and obtained in this manner is indicated in all cases involving only a single unit. This includes casts of the basal ends of roots, and of desired tooth surfaces and tooth outlines for all forms of inlay and partial crown restorations of any type.

Making Wax Pattern. When the amalgam cast is prepared thus, all surfaces to which casting wax is to be molded in making the pattern should be lubricated with thin oil. A hard casting wax should then be melted on a spatula, poured into the mold with some excess, and, when cooled, carved and trimmed to the desired outlines and proportions. A softer wax might be adapted properly, without melting, but better results always result from the use of a hard wax.

If the amalgam cast is an accurate reproduction, and if the wax pattern is made with care, the possibilities of obtaining an accurate casting are favorable, provided that all details incident to the requirements of casting are observed carefully.

When expense is of no special consideration, and where a maximum of accuracy and indestructibility in the cast is desired, amalgam casts are useful also in the application of the indirect method to the making

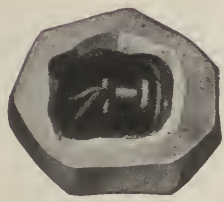


Fig. 34.

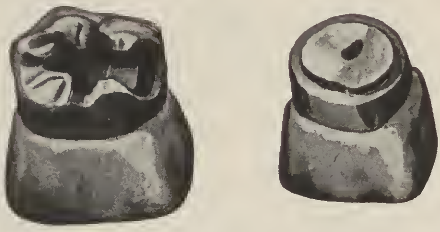


Fig. 35.

of patterns for castings which involve more than a single unit, or for castings of any size.

Plaster Impressions. For castings involving two or more units, and for castings embracing all forms of basic structures, such as saddles, accurate results will be obtained in a quicker and less expensive manner by taking the impression in plaster, and by making the cast either of plaster or of investment compound of a kind which crystallizes.

A plaster cast usually presents a smoother surface, however, than one made of investment compound; hence, unless some soldering is to be done on the cast, which is seldom, if ever, indicated, a cast made of plaster meets all the requirements necessary for making the wax pattern.

Casts Made of Plaster or Investment Compound. When a cast, made either of plaster or of investment compound, has been obtained and possesses sufficient accuracy of detail for the purpose of making the wax pattern, the outline of the pattern first should be traced upon its surface. This tracing is done best with an indelible pencil. The surface should then be treated with some form of varnish, or with a thin oil, as a means of preventing the wax pattern, which is to be molded upon it, from adhering to it.

Making Wax Pattern. The pattern should be made of casting wax, carefully molded to the desired outline, or form, and trimmed and carved

to meet the requirements. Where considerable contouring and some strength is required in the pattern, a hard casting wax, softened in water, should be used. For basic structures, such as saddles, etc., a casting wax, made in thin sheet form, is best adapted to the requirements. This may be warmed in hot water or over the flame and adapted with the fingers.

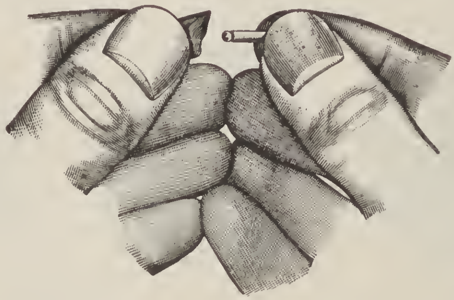


FIG. 36.

While there is very little danger of making the pattern too thin, still, very thin wax often should be reinforced in places. This may be done easily by adding a bead of melted hard wax to the surface of the softer sheet wax.

This precaution serves two purposes. It insures a retention or a preservation of the form and shape of the pattern while it is being invested. And an additional thickness of the pattern, here and there, and especially in large cases, facilitates the flowing of the metal in casting, even though this additional thickness of the casting may need to be trimmed down afterward.

As a further means of preserving the shape and form of the wax pattern in large cases, and of preventing any distortion of the pattern in investing it, a thin layer of investment compound may be painted carefully over its entire surface, after the sprue-formers have been adjusted properly and allowed to crystallize before the pattern is removed from the cast. This interferes in no manner with the subsequent complete investment of the case.

Attachment of Sprue-formers. In castings of any size, the proper adjustment and proper attachment of the sprue-former is of great importance.

Small Patterns. In patterns ranging in size from a single unit to medium-sized proportions, a single sprue-former usually will meet all requirements. This may be of metal or of wax. If of metal, provision for its subsequent removal must be made.

The size of the sprue-former must be proportionate with the size of the casting to be made, and its attachment to the pattern must be secure. The attachment should be made at a central point and upon or to a surface

Fig. 37.

which will not interfere with the fit or adaptation of the casting, or to or upon a surface which will require finishing. (Fig. 36.)

Large Patterns. In patterns for larger castings, one or more additional sprue-formers may aid materially in the rapidity with which the metal may be distributed to all parts of the mold while in the fluid state.

Any additional sprue-formers which the requirements of the case may seem to indicate should be attached to the main central sprue-former at a favorable point, and diverge from it to a position on the pattern which is favorable to a uniform distribution of the metal in casting. (Fig. 37.)

Use of Acetone. If the wax pattern is painted with or dipped in acetone just previous to investing, all extraneous matter will be removed quickly, the investment compound will adhere to its surfaces more closely, and smoother castings will result.

Investment. When the sprue-former has been attached securely, it should be adjusted to position in the base of the flask (Fig. 38), and invested.

Excepting in very small, simple castings, the wax pattern with sprue-

former attached, always should be placed in position in the flask, previous to investing. This precaution is necessary as a means of ascertaining that the position of the sprue-former, or the arrangement of the sprue-former, is accommodated by the flask. And the pattern should not come in contact with the flask at any point. If it should come in contact with the flask, a distortion of its form or a wastage of metal in casting might cause failure. When these precautions have been taken the pattern then should be invested.

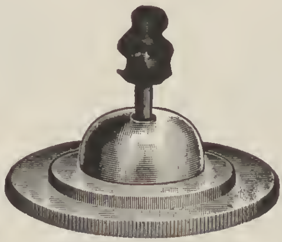


Fig. 38.

Investment Compounds. Investment compounds adapted to the purposes of casting should possess the following physical properties:

First: They must possess adequate heat-withstanding properties.

Second: They should possess a minimum of shrinkage or expansion properties.

Third: They should be of a texture sufficiently fine to insure a smooth casting.

Fourth: They also must be sufficiently porous to accommodate and take care of the contained air, which must be expelled from the mold before the casting may be made.

Fifth: They must be removed easily from the metal after casting.

A compound may possess all of these combined properties. When one which possesses these properties is used, a successful casting, in so far as the investment compound is concerned, is insured.

Vitreous Compounds. Highly vitreous compounds cannot be employed successfully.

The so-called "artificial stone," and other compounds of vitreous character, present a density of structure which reduces the possibilities for expelling the contained air from the mold. This endangers the success of the casting. Also, they are more difficult to remove from the surface of the metal after casting.

The compound used should always be thoroughly mixed, but should never be too thick. A fluid consistency should be maintained until after the investment has been completed. As a means of guarding against or of preventing the confinement of air along the surfaces of the pattern, the investment compound should be applied carefully to the surfaces of the pattern, first using an artist's small brush for the purpose.

The same compound may be used throughout the investment. No great advantage is gained through using a finer texture next to the pattern, and a coarser texture over this, provided the one compound is adapted to all of the requirements.

Fig. 39.

In investing large patterns, the use of a fluid investment compound will be found to be necessary as a medium to prevent any distortion of the pattern.

Heating Flask. The investment never should be disturbed until complete crystallization has taken place. After complete crystallization, the base of the flask should be warmed over a flame and detached, and the sprue-former of metal removed. (Fig. 39.) The case should then be heated properly and the wax burned out.

The flask should be placed over a low flame at first and should remain over a low flame until all water of crystallization has been driven off or evaporated. Then the size of the flame may be increased gradually until all wax and its gases and by-products have been dissipated thoroughly.

The position of the investment in its relation to the flame, or in its relation to the direction in which it receives the heat from the flame, is of no great importance, so long as it is heated more or less uniformly throughout.

Overheating, or heating to a red-heat, or heating to a point higher or beyond the point required to drive off or evaporate the water of crystallization and to burn out the wax and dissipate its by-products, is never indicated. It is always injurious to the integrity of the investment compound.

Overheating also increases the degree of expansion both of flask and mold, and any degree of excessive or unnecessary expansion may destroy the continuity of the mold, and the accuracy of adaptation of the casting.

For these reasons, it is evident that the most accurate results will result from casting into a mold that is only hot enough to prevent chilling the fluid metal, and which is never overheated nor overexpanded.

Casting. The casting should be made as soon as the mold has been burned out properly and heated adequately.

The alloy to be used in the casting always should be melted previously into a fresh, clean ingot of proper proportions. An ingot of alloy, freshly melted and cleaned in the acid bath, casts more freely and to more definite and accurate outlines. The use of an ingot too small, or of insufficient proportions, only invites failure. And an ingot too large is dangerous to the success of the casting when pressure machines are used. Any great over-surplus may clog up the air channels. And a sluggish, refractory alloy will not cast smoothly.

In making the casting, the alloy should be brought to a fluid state as quickly as possible, and the casting should be made the moment complete fluidity obtains. Any overheating of the alloy to be cast increases oxidation and causes it to become more refractory, both of which result in a more or less indifferent casting.

When the casting has been made, it should be allowed to cool slowly and to assume normal temperature before removing from the investment.

Casting Machines. Several different methods of casting and several different types of casting machines involving different basic principles are used. These vary from the simple method of generating and confining steam to the application of centrifugal force, and include the production of a vacuum by the displacement of the air from the mold and the utilizing of pressure in various ways.

The pressure machines in which definite, regulated pressure is obtained from compressed air, or gas, and the machines which utilize the principle of centrifugal force afford the most successful and reliable means of casting. This fact is proven especially in large castings. The application of electricity for melting purposes, used in combination with centrifugal force for casting, would be the ideal method.

In the use of any casting machine, however, the principles and the mechanism involved must be understood thoroughly. When these are understood, if the machine is kept in good order and properly and carefully manipulated, successful results usually will be insured.

Casting Flasks. Each type of casting machine usually is accompanied by a special form of casting flask adapted to its use. And some of the larger and more pretentious machines have a series of flasks varying in size to accommodate the size of the casting to be made.

Casting to Surfaces of Metal. Where it may be desirable to have some metal projecting from the wax pattern, and included as a part of it, such as pins, dowels, etc., and to cast to it, or have it picked up by the casting, and become a part of the casting, the procedure is practicable.

It is very doubtful, however, if any actual physical union occurs between the casting and the parts thus picked up. The attachment is purely a mechanical one, particularly if a high grade of alloy is used in casting. But if a physical union is desired, it may be obtained, first, by fusing solder to the surfaces to which the casting is to become attached. Or, if the alloy used in casting contains a considerable proportion of solder or is of base metal alloy, a physical union may be obtained.

Casting to Porcelain. Castings may be made directly to and upon porcelain teeth and facings, but the practice offers no advantages and presents some objectionable features.

The difference in the physical properties of metal and porcelain, and the shrinkage of alloys in casting, necessarily must endanger the integrity of any form of porcelain subjected to these influences. And, in addition thereto, the same opportunities for repair, or for the replacement of porcelain teeth, or facings, so used does not present. The subsequent attachment of the porcelain tooth, or facing, to the casting by means of cementation is always to be regarded as much safer and more reliable.

Removing Investment After Casting. Gold alloys in the fluid state have a great affinity for the silicates, and hence investment compounds which contain a large proportion of the silicates usually adhere firmly to the surface of the metal after casting, and much difficulty is experienced at times in removing all remaining traces.

Dilute hydrochloric acid at the boiling point is a slow solvent and may be used successfully. Hydrofluoric acid, however, is a better and quicker solvent Hence, all remaining traces of investment compound may be removed most quickly and thoroughly from the surfaces of gold alloy cast-

ings by immersing them in hydrofluoric acid for a few moments. A wax container of suitable size and shape must be used for this purpose.

Casting Base Metal Alloys. Base metal alloys may be cast with the same technic used in casting higher grade alloys and with equal success. Their use, however, presents no advantages over the alloys of gold, other than that of economy.

CHAPTER IX.

PREPARATION OF TEETH AND ROOTS.

If the superstructure is to endure, the foundation upon which it rests must endure. In all engineering and mechanical pursuits in any field of construction work a properly prepared foundation must be recognized as essential to the stability and durability of the superstructure.

And it must be recognized, also, that any skill displayed in building the superstructure is but a waste of energy unless equal skill is manifest in the preparation of the foundation which is to support it.

Thus, it is evident, successful achievements in construction work of any kind will depend, primarily, upon a knowledge and application of correct basic principles, and upon a close observation of all of the basic requirements fundamental to the proper preparation of the foundation.

As applied to the construction and application of crown and bridgework, a knowledge and close observation of all of the basic requirements is particularly essential, and the demands are even more exacting because the foundation is a part of the human body, and because the field of operation is confined to vital tissues.

And, furthermore, the superstructure which is to be attached to and supported by this foundation must be of a character which not only will endure, but which will not do irreparable injury. For wherever injury is done, discomfort follows, health is jeopardized and failure is invited and becomes inevitable.

The foundation must be prepared properly, therefore, even though the demands may be exacting and even though the requirements may be difficult to meet. Hence the skilful preparation of teeth and roots which are to support artificial crowns and dental bridgework must be recognized as a primary essential to the achievement of successful results.

Basic Principles.

Artificial crowns of any type are attached to their supporting roots by two different methods. Each method involves a different basic mechanical principle.

The two different basic principles involved are known in mechanics as the *telescoping* and the *dowel* principles, and all types of artificial crowns are attached to the supporting tooth, or root, by either one or the other. The basic requirements of tooth and root preparation, therefore, are dependant, necessarily, upon the principle involved in the attachment of the crown to its supporting tooth or root.

Variations. Any variation in the type of artificial crown, or any variation in the details of construction, may require some slight variation in the details of tooth or root preparation, but these variations, in the main, indicate versatility of ideas only, and this versatility will not occasion nor demand any appreciable deviation from the basic requirements.

Based upon the method by which the attachment is made to the supporting tooth, or root, all types of artificial crowns may be considered in two general classes: First, *telescope* crowns; and second, *dowel* crowns. The basic requirements of tooth and root preparations, therefore, will be considered from the respective viewpoints of this general classification.

Telescope Crowns.

Any type of crown attached to the periphery of the supporting tooth, or root, by means of telescoping over some remaining portions of the natural crown, is designated as a telescope crown.

Artificial crowns, in this classification, include full crown restorations made of gold or platinum, and with or without a shoulder; all types of jacket crowns; all types of partial crowns; and all other variations of construction in and by which fixation and permanent attachment may result by means of the telescoping or of the overlapping of the crown upon the supporting tooth, or root.

While the telescoping principle of attachment is understood generally as indicating the type of crown used in restoring the crowns of the posterior teeth, the same general principles apply to jacket crowns and to partial crown restorations upon the anterior teeth, and to all types of construction in which the attachment is made to the remaining natural crown of the tooth involved.

Dowel Crowns.

All types of crown restorations which embrace a full crown (except the jacket crown), and where the line of junction between the crown and its supporting root is at a point approximating the gingival line, may be designated as dowel crowns.

When the line of junction is made at this point the use of a dowel anchored into the body of the crown, and then extending into the root to the required depth, is necessary to the mechanical fixation and to the secure attachment of the crown. It is necessary because the shortness of the root precludes utilizing the telescoping principle to any advantage, and because the requirements of strength and permanency in the attachment demand that adequate resistance to stress must be secured.

The dowel may be a joined or a separable part of the crown, and in size and length it must be adequate to the requirements of strength. When these features are observed, a secure attachment is insured, for the reason that the stress imposed upon and assumed by the crown is distributed thus throughout the length of the supporting root to the extent to which it engages the dowel.

Dowel crowns are indicated in all restorations where the remaining natural crown of the supporting tooth has been lost, or where it is sacrificed purposely, to the gingival line; and where the esthetic requirements demand the use of porcelain teeth, or facings, in all types of construction other than jacket crowns.

The application of dowel crowns, therefore, will be confined largely to the restoration of the ten anterior maxillary and mandibular teeth, or to those teeth which are within the range of vision.

Thus, it will be observed, the basic requirements incident to the preparation of teeth and roots which are to support artificial crowns must vary necessarily with the mechanical principles involved in the method of attachment.

Preparation for Telescope Crown with Peripheral Band.

The telescope crown with peripheral band, commonly designated as the "shell" crown, when properly adapted and properly constructed, is probably one of the most useful methods of restoring the crowns of posterior teeth.

In order that this type of crown may meet the requirements of accurate adaptation, considerable preparation of the remaining natural tooth crown is demanded.

In all teeth having vital pulps the actual mechanical requirements are so exacting and at times so difficult as to cause considerable discomfort to the patient. Nevertheless, the requirements must be met properly at all times and in all cases. Any indifference to them, occasioned by sympathy or an inclination to treat them in a perfunctory manner, only lessens the possibilities for obtaining accuracy of adaptation. And accuracy of adaptation is fundamentally essential to success at all times.

Restoration of Continuity of Natural Crown.

In a very large proportion of cases, where the use of a full telescope crown is indicated, much of the natural crown and some of its remaining walls have been lost through the ravages of caries. The loss of remaining axial walls by caries frequently carries the cavity margin beneath the

Fig. 40.

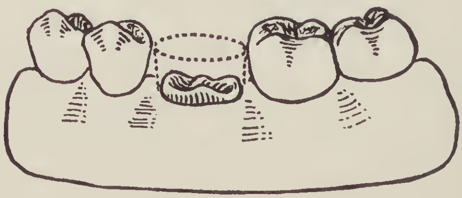


Fig. 41.

gingival line at some point. When this condition prevails, some means of effecting a permanent restoration of the continuity of the root, previous to its final preparation for the reception of a crown, is essential.

In cases of this kind some means of permanent restoration, independent of the crown, is advantageous because of the support and protection such restoration may afford. If the restoration is made properly, the integrity of all remaining walls of the natural crown is preserved, the opportunities for obtaining a better adaptation of the artificial crown to the entire circumference of the root are increased, and a more permanent restoration is insured.

Restoration with Cement. Cement will answer all requirements in effecting such restorations provided it may be completely covered with the crown, subsequently. But where the position of the cavity margin in relation to the gingiva (Fig. 40) may make it inadvisable or impossible to so adjust the edge of the crown to cover the cement completely and pro-

tect it, the best and most permanent results are obtained through the use of amalgam.

Restoration with Amalgam. In making the restoration with amalgam adequate mechanical retention must be insured. This may be obtained in vital teeth by so shaping the remaining walls of the natural crown as to insure retention; or, in pulpless teeth, the pulp chamber and root canals may be so enlarged and so shaped as to afford secure retention.

The use of a circular band made of German-silver plate, about 36 gage, to act as a matrix will facilitate the making of the restoration with amal-

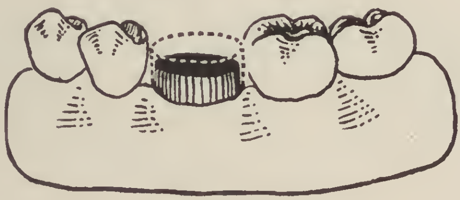


Fig. 42.

gam. When a matrix has been fitted properly and adjusted as illustrated in Fig. 41, the surface presenting toward the tooth to be restored should be covered with vaseline, melted wax, or some other medium for preventing its attachment to the amalgam and of insuring its easy detachment from the tooth and amalgam restoration after it has crystallized. As a further means of facilitating the removal of the matrix after crystallization, the amalgam never should be built up flush with the edge of the matrix. (Fig. 42.)

If the walls of the remaining tooth crown are just smeared with thin, well-mixed cement immediately preceding the packing of the amalgam, the adhesive properties of the cement will strengthen the remaining walls and insure a closer and better adaptation of the amalgam restoration to the tooth.

In instances where the entire natural crown has been lost, or must be sacrificed to a point approximating the gingiva, and where the use of a telescope crown may be desirable, one or the other of two procedures must be followed.

If no part of the natural crown remains, it is evident the telescoping principle of attachment will not meet the requirements. Hence, if a full telescoping crown is to be used, either the root must be partially restored first, or a dowel must be used, or both.

Such restorations may be made easily by providing adequate retention in the body of the root, adjusting a circular matrix and then building the restoration to the desired extent, shape and form with amalgam.

If opportunity for obtaining adequate anchorage of the amalgam to the root is not offered, or if a sufficiently secure anchorage seems to be doubtful, such an anchorage may be insured by first fitting a threaded dowel into one or more canals, mounting the dowel or dowels with cement, and then building the amalgam restoration around their projecting ends. (Fig. 43.)

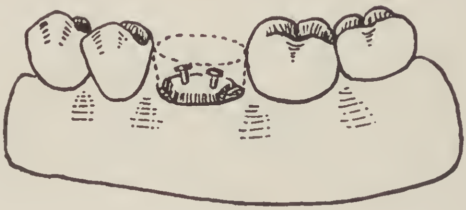


Fig. 43.

When the amalgam has crystallized, the matrix should be detached and removed, and the restoration then thoroughly finished and polished.

Since the crown to be adjusted subsequently can offer no greater permanency, and no more freedom from irritation than is insured by the restoration itself, the restoration should be properly finished before fitting and mounting the crown.

Shaping Remaining Natural Crown.

The natural crowns of typically formed teeth present their greatest circumference at the contact point. The gingival edge of a telescope crown must be adapted closely to the supporting tooth at some point between the contact points and the gingivæ.

Therefore it is evident that the proportions of the entire natural crown, or of any of its remaining axial walls, must be reduced until the greatest circumference presents at the immediate point to which the crown is expected to fit. Any degree of accuracy of adaptation of a telescope crown to its supporting tooth, or root, is impossible unless this absolute mechanical requirement is observed.

Hence the natural crown of a tooth which is to support a telescope crown must be shaped in such manner as to insure accurate adaptation. Comfort, health, usefulness and permanency depend entirely and completely upon the absence of mechanical irritation, and while unnecessary

or ruthless mutilation or destruction of any part of the crown of a natural tooth is never warrantable, yet the mechanical requirements demand that all axial walls be reduced until the greatest circumference presents at the point to which the final adaptation of the artificial crown is to be made.

In reducing the natural crowns of typically formed teeth, and in shaping the remaining walls to meet this requirement, it will be observed that considerable tooth structure must be sacrificed along all axial walls and including the occlusal surface. (Fig. 44.) The occlusal surface must be sacrificed to an extent that will provide adequate space for its proper reproduction in the artificial crown.

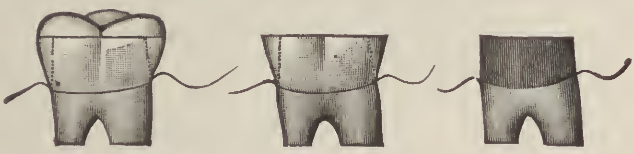


Fig. 44.

To increase further the opportunities for insuring a close and accurate adaptation of the artificial crown to its supporting tooth, or root, all remaining axial walls should be inverted slightly, rather than made straight and mutually parallel. This precaution will insure the greatest circumference at the desired point, and thus cause the crown to fit more closely as it is forced to its proper position.

If irritation is to be avoided and if health and comfort are to obtain and are to be maintained, the gingival edge of an artificial crown never should be permitted to encroach upon the investing tissues, nor to pass beneath the free margin of the gingivæ. This will be possible only in proportion to the favorable shaping of the tooth, or root, to meet this requirement.

Paralleling Converging or Diverging Teeth.

Once the normal denture has been disturbed by the loss of a single unit, the loss is followed by the migration of the adjacent units. They migrate toward the space left vacant by the missing unit, but they do not migrate along lines perpendicular with their long axis. Because of the loss of contact with the adjacent tooth the normal occlusal relationship is no longer sustained, and, hence, they are no longer normally fortified against the influences of stress. They move along the line of least resistance and their crowns move more than their roots. Hence they *tip*—converge

toward, or diverge from one another. (Fig. 45.) This tipping, or converging, or diverging continues indefinitely, or, at least, until the affected teeth find a relationship with their opponents which sustains them even though their normal functional activity may be greatly impaired or lost entirely.

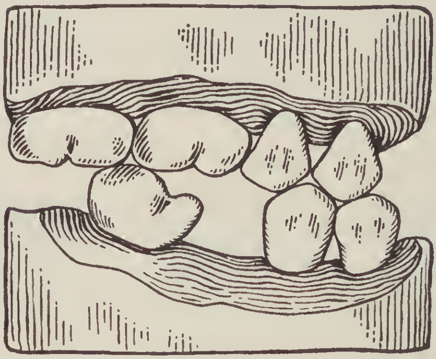


Fig. 45.

This migration is to be prevented only by the replacement of the missing unit immediately following its loss. But when immediate replacement is not made, and migration has started, it can be arrested and normal functional activity restored by the application of some form of bridgework. Thus, it often may become necessary to attach bridgework to converging or diverging teeth as a means of preventing migration and of restoring functional activity.

In such cases, all of the basic requirements incident to the preparation of the remaining natural crown which is to be restored as a single unit by means of the telescope crown, must be observed. And, in addition, the remaining natural crowns must be made to present perpendicular and mutually parallel lines in order that any type of restoration in which the telescope crown is used may be made effectively.

Operative Procedure. In the preparation or proper shaping of the remaining natural crowns of molar and bicuspid teeth for telescope crowns with a peripheral band, the operative procedure incident to an observation of all the mechanical requirements is both difficult and exacting. It is difficult particularly when teeth with vital pulps are involved, because the patient usually and necessarily is subjected to considerable discomfort; and it is exacting because the requirements must be observed, irrespective of the degree of discomfort.

The procedure may be greatly facilitated and the degree and extent of discomfort lessened, however, by the use of a good assortment of carborundum stones which cut clean and run true; and by the use of new, sharp burs, when the use of burs is indicated. Vibration, and consequent discomfort in the use of carborundum stones, is increased or decreased in proportion as they may cut clean and run true. And any overheating of

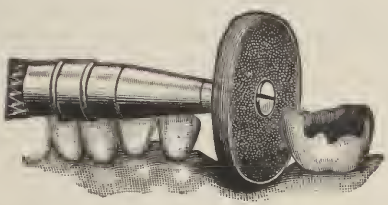


Fig. 46.

the tooth may be avoided by the use of a spray of tepid water, directed upon the stone during the procedure. The use of cutting stones of any kind which are not mounted true, or which are so worn as to present an irregular cutting edge, only increases vibration and adds to the discomfort of the patient.

The occlusal surface of all remaining walls should be removed to the desired point first, by using a thick-edged stone of proper diameter for the purpose.

The buccal and lingual walls should be properly reduced then, and this may be done best, first with a thick or blunt-edged stone of proper dimensions, and later with a thin-edged stone. Care must be exercised to avoid the formation of a groove, or shoulder, and to insure a smooth, continuous surface.

When the occlusal, buccal and lingual surfaces have been reduced properly, the mesial and distal surfaces, where the greatest difficulty will be encountered, should be reduced likewise. For this purpose thin carborundum separating disks are most useful, and a small, cross-cut fissure bur may be used also to advantage. Safe-edged, side-cutting stones (Fig. 46) and inverted cone and other shapes of stones also are useful frequently.

The use of enamel cleavers is seldom indicated in the preparation of bicuspids and molars for a telescope crown. Such instruments are not applicable to the removal of enamel of the density and to the proportions here indicated.

When all surfaces have been reduced thus, the preparation should be completed by the rounding of all sharp angles. (Fig. 47.) The degree of

accuracy obtained in the completed preparation will be evidenced by the ease with which a measurement wire, twisted taut around the circumference, at the point where the edge of the crown is expected to fit, may be removed.

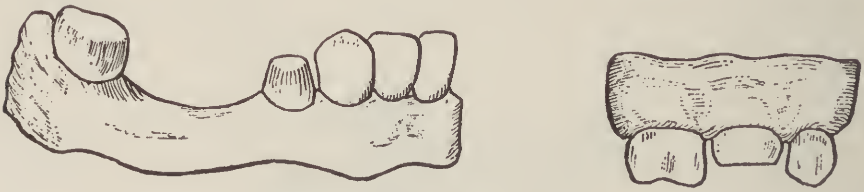


Fig. 47.

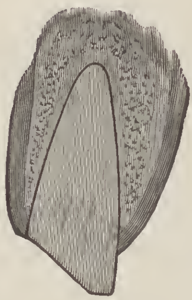


Fig. 48.

Variations. Where the esthetic requirements demand the use of porcelain, the telescope crown, made of gold or platinum, often may be used in combination with porcelain facings, in which only a slight variation in the requirements of tooth, or root, preparation will be demanded.

The variation consists only in reducing the buccal wall to an extent sufficient to accommodate the presence of a porcelain facing as a component part of the completed crown. (Fig. 48.) This may be done after the requirements of preparation in all other directions, as indicated, have been observed.

Preparation for Shoulder Crowns.

The basic requirements for tooth and root preparation for shoulder crowns of any type fundamentally are the same as the requirements for

any type of telescope crown. They differ only in the formation of a shoulder at the gingival line, or at a point just within the gingival border.

Full Shoulder Crown Restorations. Full shoulder crown restorations are made of gold and of porcelain. The application of full shoulder crowns made of gold is confined almost entirely to the restoration of the molar and bicuspid teeth. Full crown restorations made of porcelain are not limited in their application. This type of restoration is known as the "jacket" crown, and is applicable, more or less universally, to the restoration of all teeth of the denture. The preparation of the supporting tooth is the same, practically, for either gold or porcelain, and varies only as it applies to the teeth involved in the preparation.

Preparation for Full Shoulder Gold Crowns.

In the preparation of the remaining crowns of molar and bicuspid teeth for the application of full shoulder gold crowns, all requirements incident to the reduction of the occlusal surface and remaining walls should be observed.

The occlusal surface should be reduced first, using a small, thick-edged stone for the purpose. Except where the natural tooth crown has been worn so as to present a flat surface, the reduction of the occlusal surface should be made to follow the shape and outlines of the original cusp formation. By observing this feature, tooth structure is conserved, the pulp is protected better and resistance to normal stress in all directions is increased.

The mesial and distal surfaces then should be reduced to a point just within the gingival border, using a thin vulcan-carborundum disk, about seven-eighths inch in diameter, for the purpose. By using disks of this kind a shoulder may be formed at the desired point, its extent being coincident with the thickness of the disk.

The buccal and linqual surfaces then should be reduced to the required dimensions, using a small, flat-edged stone about one-half to five-eighths inch in diameter. When these surfaces are reduced thus the shoulder should be formed. The formation of a shoulder may be accomplished best by the use of small stones of cylinder shape. These stones should be used either in the straight or right-angle hand-piece, as the requirements may demand.

When the shoulder is formed thus upon all surfaces the angles should be rounded and the shoulder made smooth and continuous around the entire circumference of the tooth. The angles may be rounded best by the

use of fissure burs and the shoulder should be of uniform thickness, not less than one millimeter, nor more than one and one-half millimeters. (Fig. 49.)

Where the buccal and linqual walls of the remaining natural crown are good, and where their conservation may be desirable, full shoulder crowns may be made without sacrificing these surfaces entirely by forming the

Fig. 49.

Fig. 50.

shoulder at any point between the occlusal angle and the gingiva. (Fig. 50.)

As any unnecessary display of gold is always objectionable, a conservation of these walls adds materially to the esthetic results.

Either of these types of full gold shoulder crowns may be used as a means of restoring the tooth as a single unit, or as a means of obtaining anchorage for bridgework without deviating from the requirements of tooth preparation.

Preparation for Partial Shoulder Gold Crowns.

Partial shoulder crowns made of gold and possessing all of the advantages of a full shoulder crown, together with a conservation of the entire buccal and labial surfaces of the supporting teeth, are used frequently.

This type is known commonly as the "three-quarter" crown. It is not indicated nor used as a means of restoring the natural tooth crown as a single unit, but it is a most useful and valuable means of obtaining attachment to the crowns of teeth having vital pulps, for the purpose of anchorage for bridgework.

The same basic requirements indicated for the preparation for a full shoulder crown are essential to the preparation for a partial shoulder crown, except that the buccal or labial surface of the supporting tooth is not involved.

Preparation of Posterior Teeth. In the preparation of molars and bicuspids for partial shoulder crowns, the mesial, distal and lingual surfaces are prepared in exactly the same manner indicated for full shoulder crowns, but some additional preparation is demanded to prevent displacement and to insure secure mechanical fixation.

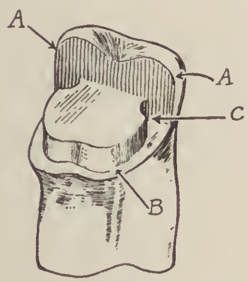


FIG. 51.

FIG. 52.

This additional requirement should be obtained after the shoulder has been formed, and consists in grooving slightly the mesial and distal axial walls to a sufficient depth toward the pulp, parallel with the long axis of the tooth, and to lines parallel to each other at a point immediately lingual to the remaining buccal wall, as indicated in Fig. 51.

If the greatest distance from mesial to distal surfaces is from A to A, and the next greatest distance is at B, with the shortest distance at C, any possibility of displacement is overcome, and a secure mechanical fixation is insured.

These retention grooves may be made best with a fissure bur of proper size and it is essential that these grooves should be placed parallel with the long axis of the tooth and parallel with each other.

The typical preparation for biscuspid teeth is illustrated in Fig. 52.

Preparation of Anterior Teeth. In the preparation of anterior teeth for the application of partial shoulder crowns, the basic requirements are the same in all details except that the mesial and distal retention grooves *should not* be placed parallel with the long axis of the tooth.

The secure retention of partial shoulder crowns applied to anterior teeth will depend entirely upon the position of the retention grooves in their relation to the supporting natural crown; hence, their proper position is of great importance.

Because of the normal gingival curvature, the shortest distance from the incisal end to the gingiva presents at the center, labiolingually, of the mesial and distal surfaces of the natural crown, if measured by lines drawn parallel with the long axis of the tooth. If the retention grooves are made along lines parallel with the long axis of the tooth they are placed at a point where they necessarily must be the shortest. But a maximum, rather than a minimum length of retention grooves is necessary to insure

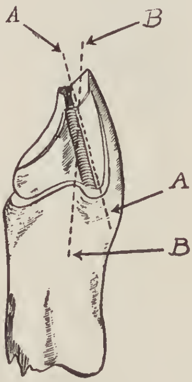


Fig. 53.

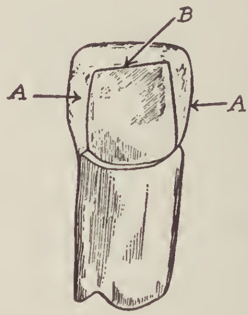


Fig. 54.

strength in the attachment; hence, in order that a maximum of strength may obtain, the retention grooves must be placed parallel with the labial plate of enamel, as indicated in Fig. 53, A to A and not parallel with the long axis of the tooth as indicated in the line drawn from B to B.

When the retention grooves are placed at this angle, Fig. 54, A, and are terminated in an incisal groove, Fig. 54, B, the length of the retention area will be nearly equal to the entire circumference of the natural crown, and stability in the attachment will be insured.

Whenever the thickness of the incisal end of the natural crown will permit, an incisal groove made at the expense of the lingual plate of enamel and extending from mesial to distal angles always should be made.

Enamel Margins. After cutting the retention grooves, the enamel margins and all sharp angles should be beveled slightly. No preparation in which the formation of enamel margins is involved is ever complete unless the preparation embraces the protection of all remaining short enamel rods. Hence, a knowledge of the histology of the teeth is essential primarily, in order that this protection may be supplied in all cases.

In cases where the remaining natural crowns of anterior teeth are very thin labiolingually, and where no cingulum and only a gradual sloping

convexity from gingivæ to incisal end presents, the formation of an incisal groove may be impracticable. In such cases incisal retention may be abandoned and compensated for by utilizing the lingual pit. The lingual pit may be deepened and enlarged sufficiently to receive and engage a small pin, as illustrated in Fig. 55, with every assurance of affording adequate strength in the attachment.

The requirements of preparation are very exacting, and, because of

Fig. 55.

Fig. 56.

the size of the natural crowns, such crowns are more generally applicable to the upper central incisors and to the upper and lower cuspids than to the upper laterals and lower incisors. The typical preparation for an upper cuspid is illustrated in Fig. 56.

On account of the natural tipping of the anterior teeth and the more perpendicular position assumed by the posterior teeth, the placing of the retention grooves on a line parallel with the labial plate of enamel in the preparation of anterior teeth and the placing of these grooves on a line parallel with the long axis of the teeth in the preparation of posterior teeth will not preclude, necessarily, the utilizing of both anterior and posterior attachments combined in one fixture. But care must be exercised, of course, to make the preparation in such manner as will insure a proper alinement of one with the other.

Preparation for Full Shoulder Porcelain Crowns.

Full shoulder crowns made entirely of porcelain are designated generally as porcelain "jacket" crowns, or as a porcelain "veneer" crowns. Neither term is expressive of a scientific nomenclature, but by common usage both terms are accepted and recognized as meaning a full all-porce-

lain shoulder crown. In the absence of a more scientific term the older of these terms—"jacket" crown—will be used.

All of the basic requirements fundamental to the preparation of the remaining natural crown for the application of a shoulder crown made of gold, apply to, and must be observed in, the preparation for porcelain jacket crowns. Indeed, the requirements are even more exacting and must be observed even more closely for the reason that porcelain is not an indestructible substance.

On the contrary, porcelain is a friable substance, and, being friable, will possess strength equal to the requirements of crown restoration, only when it may be adequately protected against the influences of stress.

Protection against stress will obtain from resistance to stress; and resistance to stress will be increased in proportion as the supporting natural crown is prepared properly to protect the porcelain restoration adequately and to insure for it a maximum of resistance to stress.

A study of the histological structures of the teeth shows how wonderfully the enamel is supported and protected against stress by the formation of the dentin.

Therefore, since it is difficult to improve upon Nature's plan, and since the porcelain restoration is to take the place of the enamel, it should be protected and supported in much the same manner as the enamel is protected and supported.

Indeed, if by some metaphysical means it might be possible completely to denude the natural crown of a tooth of its enamel, the normal formation of the supporting dentin would be most favorable to the support and protection of an all-porcelain jacket crown.

Hence, the requirements of preparation will be met in the most successful manner by so removing the enamel, and by so shaping the remaining natural crown as to leave the supporting dentin much as its normal outlines present originally. The formation of a shoulder is advantageous only as a means of affording a definite line of junction between the crown and its supporting tooth.

Because of the friability of porcelain a definite line of junction is essential to the requirements of strength. It is essential, also, to the preservation of accuracy in the adaptation. Thin, attenuated edges of porcelain are brittle, and hence must be avoided. And, because of this brittleness, sufficient thickness must exist always to insure adequate strength. For this reason the preparation of a shoulder is advantageous.

In denuding the remaining natural crown of its enamel, in properly shaping the supporting dentin, and in forming the shoulder, the following basic requirements must be observed:

Coronal Preparation. First: When properly prepared, the remaining coronal proportions of the natural teeth should assume the general outlines of the original formation of the dentin. This preparation is absolutely necessary in order that normal resistance to stress may obtain.

Second: When the original outline of the supporting dentin obtains, the remaining coronal proportions should then be tapered slightly in order that the greatest circumference may present at the point where the shoulder is to be placed.

Third: The completed preparation must be free from all undercuts, and all sharp angles must be rounded.

Shoulder Preparation. First: The shoulder should be placed slightly within the free gingival margin. This is necessary in order that the immediate joint between crown and root may be placed at a point where it will be both inconspicuous and immune to the action of secretions.

Second: The shoulder should be of a thickness not less than one millimeter, and should be uniform and continuous around the entire circumference of the tooth.

These basic requirements apply to the preparation of both anterior and posterior teeth and to teeth having vital pulps, as well as to pulpless teeth.

Preparation of Teeth Having Vital Pulps. In the preparation of teeth having vital pulps, extreme care must be taken always to avoid overheating, and to minimize the usual attending discomfort. Pulp vitality may be impaired or greatly endangered by overheating. In the use of stones the attending discomfort may be reduced and overheating may be prevented by the constant application of a stream of tepid water directed upon the stone while grinding. When steel instruments are used, compressed air played upon the tooth will answer the same purpose. These precautions should be observed in all cases.

Preparation of Pulpless Teeth. Even though pulpless teeth are not so responsive to overheating, the same care always should be exercised to prevent any unnecessary discomfort and to facilitate the operative procedure.

Operative Procedure.

In the operative procedure incident to the preparation of the remaining natural crown for jacket restorations, only a few instruments are necessary. Too many are confusing. A good selection of stones of varying sizes and shapes, and a few special forms of burs are all that will be required.

The angle outlines should be made first and no effort should be made

to form the shoulder until the remaining natural crown has been reduced to the proper and desired outlines.

Anterior Teeth. In the preparation of the incisors and cuspids, the incisal end of the remaining natural crown should be removed first. This

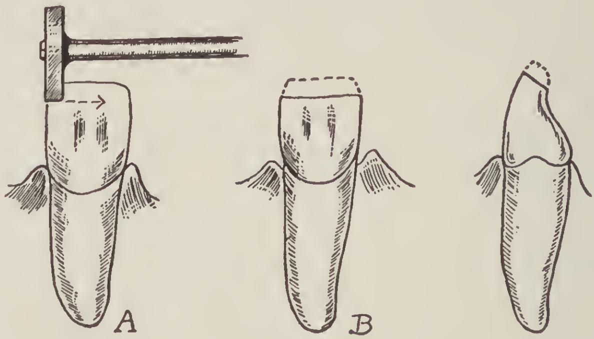


Fig. 57.

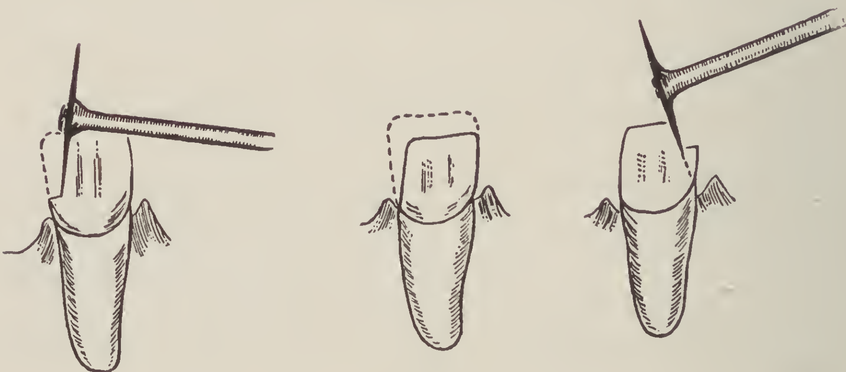


Fig. 58.

edge should be cut away to a point approximating the line of junction between the enamel and the dentin, or to a point slightly deeper than this junction (Fig. 57, A to B) and it should be cut away on a plane inclining slightly toward the lingual surface (Fig. 57 C). A flat-edged stone from five-eighths to three-fourths of an inch in diameter is adapted best to this purpose.

The mesial and distal angles should be removed in such manner as to assume a slight taper from incisal end to gingivæ, as illustrated in Fig. 58. A thin vulco-carborundum disk, about seven-eighths of an inch in diameter, is invaluable for this purpose.

The labial and lingual surfaces are then reduced. A small, thin, flat-

edged carborundum stone about five-eighths inch in diameter will be found effective for this purpose.

When all surfaces have been reduced thus (Fig. 59 A) the angles should be rounded. The rounding of the angles may be accomplished by

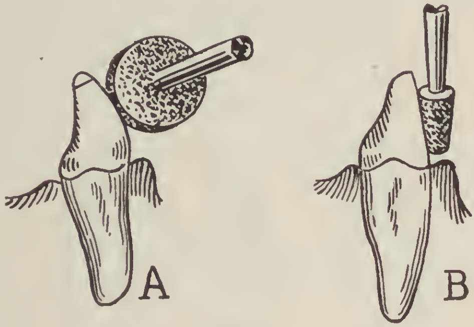


FIG. 59.

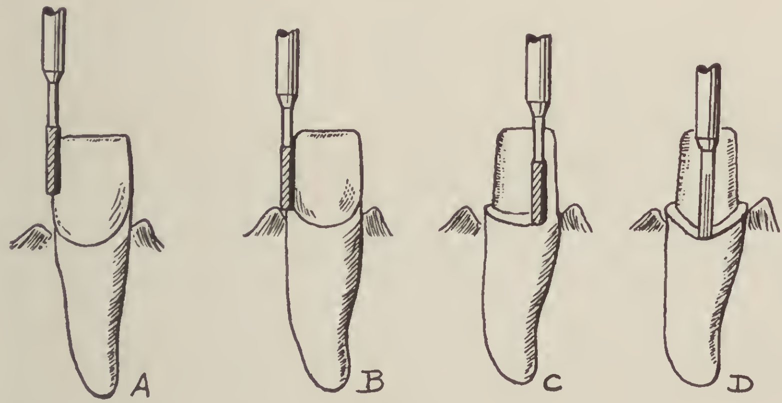


FIG. 60.

using a small stone, cone-shaped (Fig. 59 B) followed by the use of sand-paper disks.

The shoulder is formed immediately thereafter. Small cone- and cylinder-shaped stones are used to start with, and these are followed by the use of plain, straight-sided fissure burs. In using fissure burs, the tool should be placed on a line parallel with the labial surface first (Fig. 60 A) and then forced rootwise until its end reaches the point just within the gingival border, at which the shoulder is to be placed. (Fig. 60 B.) The bur is then carried laterally (Fig. 60 C) until the shoulder is made continuous and of the desired thickness around the entire circumference. (Fig. 60 D.)

An end-cutting bur, designed for the purpose, is used to complete the formation by making the shoulder straight and smooth. The formation of the shoulder having been thus completed, sandpaper disks should be used to smooth and round all angles and surfaces. (Fig. 61.)

Posterior Teeth. In the preparation of bicuspids and molars, the occlusal surfaces should be reduced first, and in the manner described for the preparation for shoulder crowns made of gold. This surface never should be ground off flat, except where the natural crown has been worn

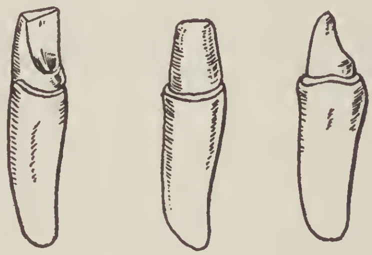


FIG. 61.

down, but should be shaped to follow the planes of the original cusp formation.

The mesial and distal surfaces should be cut away, using a thin vulcan-carborundum separating disk, held at such an angle in its relation to the long axis of the tooth as will cause these surfaces to be slightly tapered, and, at the same time, to make a shoulder of the thickness of the disk at the desired point within the gingival border.

The buccal and lingual surfaces then should be reduced as indicated. The reduction of the mesial, distal, buccal and lingual surfaces thus completed to the desired extent, the angles may be rounded and the shoulder upon the buccal and lingual surfaces made with small, cylinder-shaped stones, used in straight or right-angle handpiece as the requirements may demand. The shoulder then may be made of uniform thickness, and smooth and continuous around the entire circumference, by the use of fissure burs.

Much of the success of porcelain jacket crowns depends upon the formation of the shoulder and every effort must be made to meet the requirements of shoulder formation with definiteness and exactness.

Care must be exercised to place the shoulder where it should be placed, and the precaution of not cutting too much must be observed always.

Restoring Roots, Reduced to Gingival Border. In cases where all of the remaining natural crown has been, or must be, sacrificed

to a point approximating the gingivæ, the application of porcelain jacket crowns still may be made successfully. The preparation is simple.

In such cases the entire basal end of the root first should be trimmed smooth and even to a point just within the free gingival margin. The canals may be enlarged sufficiently then to receive and accommodate a dowel and a restoration of the body of the natural tooth crown is made by casting.

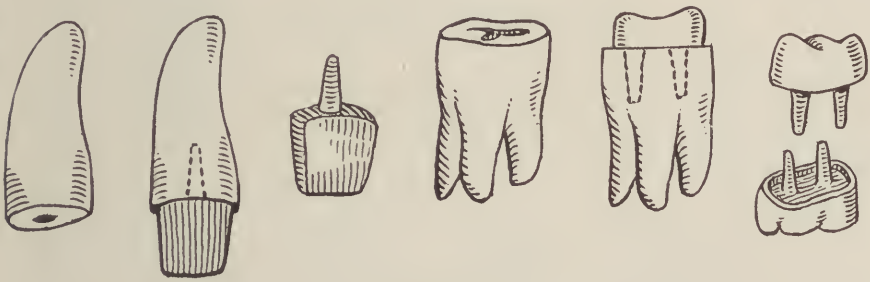


Fig. 62.

This restoration is called an "internal cone" and is made in such manner as to form a shoulder by leaving the marginal edge of the entire periphery of the root freely exposed. (Fig. 62.)

The internal cone restoration should be formed, or shaped, to follow the outlines of the original contour of the dentin, and the dowel, or dowels, should be an integral part of the restoration. It should be cast in gold, and when cast, finished and polished, it should be cemented to place on the root.

Where the remaining natural root is fragile, or where caries may have reduced one surface below the normal gingival line, a somewhat different technic is demanded. In such cases, the cone should be extended to cover and protect the free margins of the natural root, except at the labial (or buccal) aspect and the shoulder should be made on the cone. When this method is used the porcelain jacket is in contact with the root end, at the labial (or buccal) margin but with the gold at the other three sides. A cone thus constructed protects the end of the root, but should not be high enough above the gingival margin to reduce the bulk of the porcelain, and thus weaken the crown.

Reduced roots are restored thus in a very simple and effective manner. One or more dowels may be used in accordance with the requirements of the root to be restored.

Preparation of Teeth Having Vital Pulps for Attachments for Bridgework.

While full and partial shoulder crowns, perhaps, are the most generally useful methods of obtaining attachment to the crowns of teeth having vital pulps for the anchorage of bridgework, still, more simple methods involving a less complicated preparation are possible and indicated at times.

Preparation for Inlays.

Cast gold inlays frequently provide a useful method of obtaining attachments for bridgework and, particularly, in cases where the natural tooth crown already has been partially wrecked by caries, or where fillings are present.

Where inlays are to be used for this purpose, the requirements of preparation demand that the remaining natural crown be prepared to insure every degree of strength in the attachment of the inlay, which resistance to stress in all directions, as well as permanency, will require.

These requirements demand:

First: That all thin, unsupported or weakened walls be trimmed down until adequate strength in the supporting tooth crown is assured.

Second: That all cavity margins be extended to areas immune from contact with any part of the structure which is to be supported by the inlay.

Third: The preparation must be made in such manner as to lock the inlay mechanically into place in its relation to the supporting tooth crown, and thus fortify it against the influences of stress in all directions.

Unless resistance to stress in all directions is afforded and insured by the strength of the supporting tooth crown, and by the shape and form of cavity preparation, both combined, small holes for the accommodation of one or more short pins or dowels, should be provided.

In teeth having vital pulps, the drilling of holes in the dentin for the accommodation of pins or dowels, of any size or length is both difficult and dangerous. Therefore, whenever this additional security is deemed necessary, every precaution must be taken to place the holes at points where pulp exposure, or pulp vitality, will not be endangered.

In the preparation of the crowns of pulpless teeth, the pulp canal should be used, of course, for the accommodation of the dowel. Where a pulp canal may be used, one dowel, usually, is all that will be required.

Preparation of Anterior Teeth. A type of preparation involving the incisal end and mesial and distal surfaces of upper anterior teeth is illustrated in Fig. 63, and another variation involving a more extensive preparation of the lingual surface, and *only* the mesial *or* distal surface together

Fig. 63.

Fig. 64.

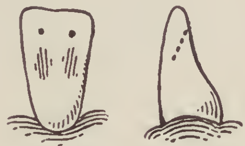


Fig. 65.

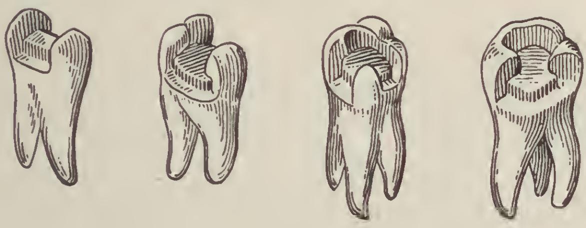


Fig. 66.

with a partial shoulder and a small pin placed in the lingual pit is illustrated in Fig. 64.

These two forms of preparation are applicable, generally, to the six upper anterior teeth, and are useful when the preparation may be made in accordance with all the basic requirements.

As a rule, the crowns of the six lower anterior teeth, and particularly of the incisors, are too small to accommodate such extensive preparation without endangering the vitality of the pulp.

A simpler and less dangerous preparation, useful and generally applicable to the lower incisors, consists in placing two small holes parallel with each other, and vertical with the long axis of the tooth at a point on the lingual surface near the incisal end. (Fig. 65.)

The holes should be about three millimeters in depth and of a size which will accommodate pins made of round iridio-platinum, or clasp-metal wire 18 to 20 gage. Wherever such holes may be placed successfully, a more or less secure form of attachment may be made.

Preparation of Posterior Teeth. The preparation of cavities in the crowns of bicuspids and molars must include an observation of all the basic requirements. A series of typical cavity preparations is illustrated in Fig. 66, and the use of pins in conjunction with otherwise favorable cavity outlines is illustrated in Fig. 67.

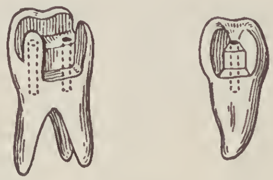


Fig. 67.

Preparation for Combination Inlay and Partial Peripheral Band.

A useful method of attachment to the crowns of posterior teeth involve the use of an inlay in combination with a partial peripheral band. This type of attachment is known as the McBoyle attachment. It is applicable to teeth having vital pulps, as well as to pulpless teeth.

The use of a partial peripheral band in combination with an inlay affords a method of attachment possessing several advantageous features:

First: Less extensive cavity preparation is required.

Second: The peripheral band, being adapted to the largest circumference of the crown of the supporting tooth, requires but little preparation of the periphery.

Third: The addition of the peripheral band adds materially to the strength of the attachment, even though the inlay is less extensive.

Fourth: All margins of the attachment are carried beyond any possible contact with the bridgework structure.

Fifth: Gingival contact and any resulting gingival irritation are avoided.

Requirements. The requirements of preparation for this type of attachment, while demanding less extensive cavity preparation, demand that the inlay be seated well in and securely anchored to the natural tooth crown which is to support it, and that the peripheral band must be adapted closely to its supporting walls. And when two attachments are to be used in one fixture, the surfaces of the natural crowns which present toward each other must be made parallel the one with the other. The reduction of

these surfaces, of course, is made at the expense of the enamel and may denude the dentin entirely, but when any appreciable reduction becomes necessary, it is restored with and by the peripheral band.

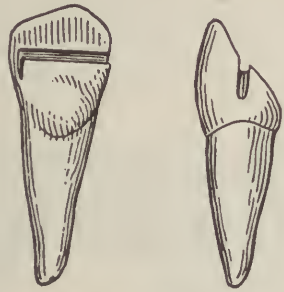


FIG. 68.

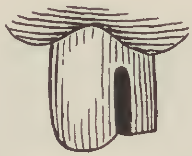


FIG. 69.

Preparation for Simple Groove Attachments.

Attachments, the use of which involves and requires but a minimum of destruction of the supporting natural tooth crown, may be designated as "groove" attachments. They also are known as Carmichael and Alexander attachments. This type of attachment may be used successfully when its application is confined to cuspids and bicuspids.

The requirements of preparation involve the cutting of lateral and of incisal or occlusal retention grooves, and of shaping the mesial and distal walls to present parallel lines, and sacrificing the lingual or occlusal surfaces to receive and accommodate the attachment.

The cutting of the retention grooves is accomplished in the manner indicated for partial shoulder crowns, and, except that no shoulder is made, all other requirements are the same.

The requirements of preparation, as applied to the crowns of cuspid teeth, are illustrated in Fig. 68, and as applied to bicuspids in Fig. 69.

Preparation for Open-face Partial Crowns.

Gold telescope crowns with a large portion of the labial surface cut away leaving only a narrow band presenting upon this surface, and covering all other surfaces of the supporting tooth crown, are used sometimes as a means of obtaining attachment for bridgework. This type of attachment is known as an "open-face" crown, and, wherever indicated,

its application may be made without sacrificing or mutilating the natural tooth crown to any appreciable extent.

If a maximum of conservation of the natural tooth crown is necessary, the application of this type of attachment is limited to cases where the natural tooth crown is of favorable conformation primarily. A primarily favorable shape, or a primarily favorable conformation will be found to limit a successful application to the cuspid teeth exclusively.

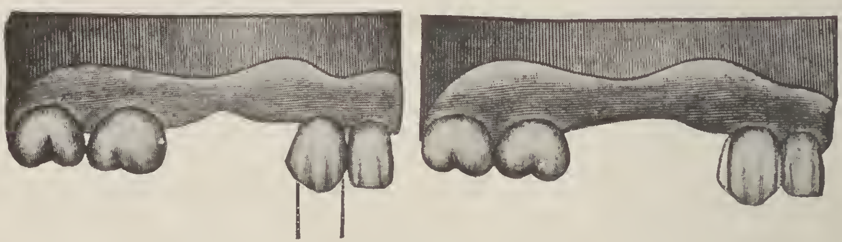


FIG. 70.

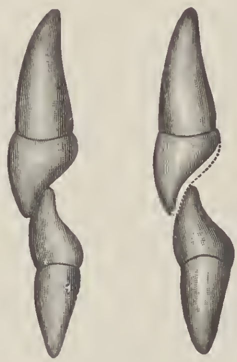


FIG. 71.

The requirements simply demand that the mesial and distal surfaces of the supporting tooth crown be made parallel with each other (Fig. 70) and that the lingual surface be sacrificed to an extent sufficient to accommodate the thickness of the gold which is to cover it. (Fig. 71.)

Preparation of Roots for Dowel Crowns.

Various types of all-porcelain dowel crowns are manufactured and may be purchased. Their adaptation to the supporting root is obtained by grinding the basal end of the crown to fit the root as closely as possible.

A better and more permanent adaptation to the root, however, is obtained by making a coping of gold or platinum to meet more perfectly the requirements of adaptation, and building the crown upon this coping.

Root-end Copings. In the construction of dowel crowns the term "coping" is used to designate the base of the crown, or that part of the crown which is adapted to, or engages with, the end of the root. The

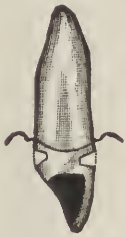


Fig. 72.

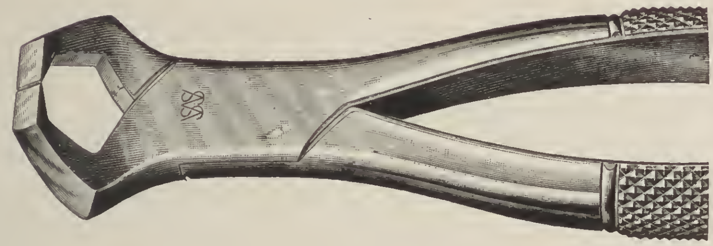


Fig. 73.

copings for dowel crowns are made with and without a peripheral band. The requirements of root preparation necessarily vary accordingly.

Preparation for Dowel Crown with Full Peripheral Band. The requirements of root preparation for a dowel crown, with a full peripheral band as a part of the coping, include all requirements indicated for telescope crowns. They vary in one feature only: all of the remaining natural crown must be sacrificed to, or near to, the gingival line.

Operative Procedure. In sacrificing the remaining portions of the natural crown, every effort to eliminate any and all unnecessary grinding, every effort to avoid shock and every effort to avoid the danger of fracturing the remaining root should be made.

Excising Remaining Natural Crowns of Incisors and Cuspids. In the incisors and cuspids, the removal of the remaining natural crown may be accomplished easily and quickly first by undermining the enamel by removing the supporting dentin with a good, sharp bur; then by cut-

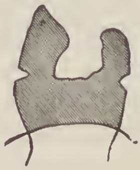


Fig. 74.

Fig. 75.

ting a groove into the labial and lingual surfaces at a point about one millimeter from the gingivæ (Fig. 72) the remaining crown may be excised easily without appreciable shock, and without danger of a root-wise fracture, by the careful use of the excising forceps. (Fig. 73.)

The remaining natural crown never should be sacrificed primarily to a point even or flush with the gingiva, because a slight surplus facilitates both the removal of the remaining enamel, and the subsequent taking of the measurement and fitting of the band.

Excising Remaining Natural Crowns of Bicuspids and Molars. The same procedure applies to the removal of the remaining natural crowns of bicuspids and molars, except that a good, sharp bur should be used to destroy the continuity of the buccal and lingual walls (Fig. 74) before using the excising forceps.

Excising forceps are useful instruments in root preparation, but extreme care to prevent unnecessary shock, or fracturing of the remaining root beyond the desired point, should be observed always.

Removal of Enamel. Wherever a peripheral band is to be used, all of the remaining enamel must be removed. The removal of the remaining enamel may be effected in the best and quickest manner by means of "enamel cleavers." (Fig. 75.)

Use of Enamel Cleavers. Enamel cleavers are useful only in proportion as they may be used properly. Several designs are obtainable. They are made with a strong, blunt end and a sharp, cutting edge. In their use the cutting edge must be held in its proper relation to the axial

Fig. 76.

Fig. 77 A.

walls of the root, and a fulcrum must be established as a means of admitting the application of the force necessary to break the continuity of the remaining ledge of enamel and to detach it from its supporting structure.

To establish a fulcrum, the handle of the instrument should be grasped firmly and the thumb rested steadily upon the incisal ends of the crowns of the adjacent teeth. (Fig. 76.)

In the absence of adjacent teeth, a suitable rest may be made by molding impression compound upon the soft tissues. If molded to a good adaptation and to proper proportions, and then chilled, in cold water, enamel cleavers may be used effectively and without discomfort to the patient.

Shaping Periphery of Root. The requirements incident to the proper shaping of the periphery of the root are illustrated before shaping

and after shaping in Fig. 77 A. The correct position of the cutting point of a useful design of enamel cleaver, for first destroying the continuity of the remaining enamel, and the correct position for removing the enamel are shown in Fig. 77 B.

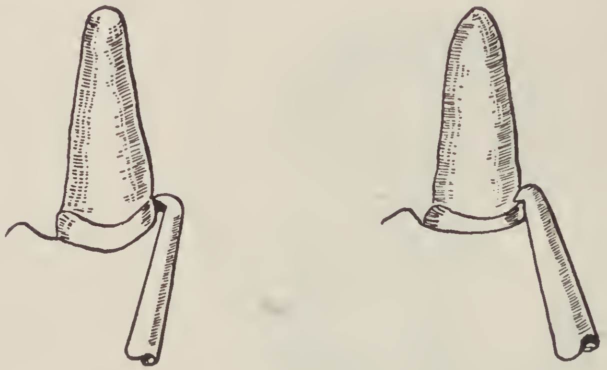


FIG. 77 B.

FIG. 78.

A small crosscut fissure bur and short blunt files (Fig. 78.) are also useful in shaping the mesial and distal surfaces.

Shaping Basal Surface of Root. The formation of the basal surface of the root is a procedure of considerable importance.

Where a crown with a full peripheral band is to be used, the basal surface should *not* be shaped finally until after the enamel has been removed, the measurement obtained, and the band fitted. All of these procedures are facilitated by allowing the root to project beyond the gingiva until they have been completed. When the final fitting of the peripheral band has been obtained, the root may be cut down to the desired point, and the proper shape given to its basal surface.

Anterior Maxillary Roots. In anterior maxillary roots, the labial surface always must be cut down to a point at least approximating, and, in some instances, even slightly beneath the gingival line. This necessarily will cause the band to be very narrow along this surface, but the requirements of esthetics preclude the use of a wide band.

The esthetic requirements do not demand that the lingual surface be cut down to the same point, and, hence, this surface may be allowed to remain longer and to project beyond the gingival line.

A projection of the root beyond the gingival line in the six anterior maxillary teeth offer a mechanical advantage. It provides more surface

for telescoping contact between it and the band, and thus it strengthens the attachment of the artificial crown to the root by fortifying the attachment against the greatest stress which is imposed. By this means resistance to stress is increased mechanically.

Fig. 79.

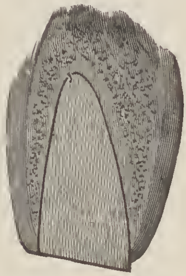


Fig. 80.

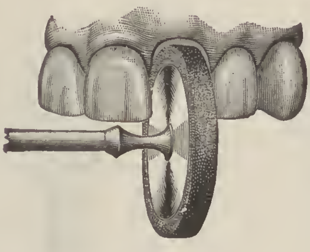


Fig. 81.

A combination of these esthetic and mechanical requirements in the formation of the basal surface will demand that the labial or buccal aspect be beveled as illustrated in Fig. 79, or that it assume a gradual inclined plane as illustrated in Fig. 80.

As any impingement is positively injurious to the health of the investing tissues, the root never should be cut down beneath the gingiva at any point, except labially or buccally. This feature should be observed unvaryingly in the formation of the basal surface of all roots.

The shape of the basal surface may be formed best with a flat-edge, true-running carborundum stone. (Fig. 81.) The stone should always be kept wet while cutting. When reduced to a point approximating the gingival curvature, with a stone, in this manner, the labial or buccal edge may then be carried to a point slightly within the free gingival margin by the

use of the Ottolengui root facer. (Fig. 82.) In choosing the root facer one should be selected the diameter of which is no greater than the mesiodistal diameter of the root end and extreme care must be exercised always to prevent any undue laceration of the investing tissues.

Fig. 82.

Fig. 83 A.

Fig. 83 B.

Mandibular Anterior, and Bicuspid and Molar Roots. In mandibular anterior teeth, and in bicuspids and molars, both maxillary and mandibular, the basal end should be cut down and shaped to follow the gingival curvature closely at all points. Adequate resistance to stress is offered, and the health of the investing tissues is conserved thereby.

Preparation for Dowel Crowns Without Peripheral Band.

In the preparation of roots for dowel crowns without a peripheral band, the requirements are the same in every respect and in every detail, except that the removal of the enamel and any peripheral preparation whatever is entirely unnecessary. And for the reason that no peripheral prepa-

ration is required and that the normal condition of the investing tissues is conserved, therefore, the advantages offered by this type of dowel crown are evident. Typical root preparation is illustrated in Fig. 83 A. Another type of preparation involves a four-sided bevel (Fig. 83 B) and is particularly useful where the coping is made by casting.

Preparation of Root Canal. The dowel plays an important rôle in the construction of all types of dowel crowns. A knowledge of the re-

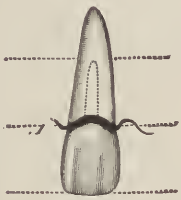


FIG. 84.

quirements of a dowel, therefore, and of the preparation of root canals for the reception of dowels, is essential.

Requirements of a Dowel. All the strength obtainable in the attachment of a dowel crown to its supporting root is afforded by the dowel itself.

The mounting medium protects the root, and the crown coping protects the mounting medium—just in proportion as the adaptation is good—but the crown coping affords but little resistance to stress. It adds but little strength to the attachment, therefore. It is evident, then that a dowel must be adequate to all requirements of strength.

To be adequate to the requirements of strength, it must be proportionate in size with the size of the root. It must extend into the root to a distance equal to the length of the crown (Fig. 84) and it must be composed of an alloy possessing inherent strength.

Where these requirements are met a single dowel, even in multi-rooted teeth, will adequately supply secure and permanent mechanical fixation. But in multi-rooted teeth it may not be possible always to prepare a single canal to receive a single dowel, meeting these requirements in size and length. In such instances two dowels, or, in rare cases, even three dowels may be needed.

The supporting root never should be weakened unnecessarily by the preparation of its canal or canals to accommodate a dowel or dowels.

In multi-rooted teeth, if the largest canal may not be prepared properly to accommodate a dowel subscribing to these requirements, then smaller and shorter dowels should be used.

In preparing the canal to receive and accommodate the dowel, tapered twist drills, or round burs of a size just slightly larger than the diameter of the dowel, should be used.

Any necessary enlargement of the canal always should be made in the direction of the lingual surface. This provision causes the surplus end of the dowel which is to project through the coping to be carried well toward the lingual aspect of the root, thus providing for the subsequent accommodation of the porcelain tooth, or facing.

Unless this precaution is taken, the subsequent proper alinement of porcelain tooth, or facing, is to be obtained only by sacrificing the surplus end of the dowel. And, if this surplus end is sacrificed to too great an extent, the strength of the relationship between the body of the crown and its supporting dowel is diminished accordingly.

Whether the crown be a combination of metal coping and porcelain tooth, or facing, or whether it be made entirely of porcelain; or whether the dowel be separate and unattached to either root or crown previous to mounting, or whether it be made an integral part of the crown before mounting, the final attachment between crown and dowel always must be made in such manner as to insure adequate strength.

The procedure should be followed with extreme care at all times and particularly in first biscuspid, molar and all constricted roots, and every effort must be made to avoid drilling through the end, or perforating the walls of the root.

Shape of Dowel. The dowel may be round, triangular or square, and, like the root which is to receive it, should be tapering throughout its entire length. Its largest diameter should be at the immediate line of junction between crown and root where the greatest strength is required. It may be threaded, or roughened with a file, as a means of insuring a more secure attachment of the mounting medium.

Alloys for Dowels. Special alloys, possessing the physical properties of inherent strength, toughness and sufficiently high fusibility should be used for dowels.

Iridio-platinum or high-fusing, round clasp-metal wire, not larger than 14 gage, nor smaller than 16 gage properly shaped to meet the requirements of the individual case is generally used for dowels.

Alloys of nickel are used, also, but dowels made of alloys containing nickel, or any of the base metals, do not alloy well with gold solders or

casting alloys and are effected to a greater or less extent by the acid bath, and by the cements used in mounting. Economy, therefore, is the only advantage obtained from their use.

Treatment of Perforated Roots.

The roots of teeth, otherwise good and healthy, may present sometimes with a perforation through their peripheral walls at some point. The perforation may be caused by accident or it may be the result of caries.

If it is the result of accident, it usually presents through the side of the root somewhere between the gingiva and the apex. Such perforations are usually made during the procedure incident to enlarging the canal for the accommodation of the dowel.

If the perforation is the result of caries, it usually presents through the walls of the pulp chamber and in between the bifurcation of the roots in multi-rooted teeth.

In either class of cases, a successful reparative procedure is difficult and doubtful. Hence, perforated roots are usually doomed to early loss.

In cases where the conservation of the root is important, however, and where the age of the patient and the general health of the root and of its investing tissues is favorable, an effort to repair the perforation is warrantable and may be attempted.

A successful reparative procedure demands that such perforation be filled under aseptic conditions and hermetically sealed with some non-irritating and insoluble substance. Gold foil, tin foil and gutta-percha are used for the purpose. If any of these is made previously into a cone, or formed into a shape approximating the size of the perforation, and then gently forced into the perforation until it is filled completely, and more or less compactly, and without forcing the material beyond the external walls of the perforation to any appreciable extent, and the filling is then covered over with cement, the procedure may be rewarded with success. At least the possibilities justify the effort.

Where the perforation presents in roots the canals of which have not been filled previously, the perforation should be filled and the protecting layer of cement allowed to become crystallized thoroughly before any effort is made to fill the canal. Otherwise, a surplus of root-filling material is certain to be forced through the perforation.

This procedure is usually facilitated by placing root-canal broaches, or wires, into the canals to the full length and size of the canals, first, and filling the perforation while the broaches, or wires, are in place, after which they may be removed gently and the canals filled at a subsequent time.

While gold foil and gutta-percha may be used successfully, the use of tin foil offers an additional advantage over each. If the perforation is filled successfully with tin foil, under the influence of temperature and moisture, the oxid of tin is formed and a more hermetical sealing is afforded thereby.

Treatment of Fractured Roots.

The roots of teeth are fractured frequently, either as a result of accident or from the influence of stress. A fractured root often is a hopeless root and the proper treatment consists usually in its immediate removal.

There may be instances, however, where the nature of the fracture, the age of the patient, the importance of the tooth, the desirability of its retention and the general health of the investing tissues, all combined, would indicate and justify some effort toward the conservation of fractured roots.

Anterior Roots. A very large proportion of the fractured roots in which any great effort toward their conservation would be at all justifiable would be confined to the anterior teeth.

Fractures of the roots of anterior teeth usually present labiolingually, with the labial portion broken away from the body of the root. Where the fractured portion does not extend any great distance beyond the alveolar border it is best to remove the fractured portion, compress the soft tissues with gutta-percha, or temporary stopping, until the end of the remaining root is exposed freely, and then effect the restoration of the lost section with and as a part of the artificial crown. This may be accomplished best by means of the indirect method. Where the restoration is not too extensive good results may result.

Where the fracture extends beyond the alveolar border to any great extent, any mechanical treatment is usually hopeless, and the removal of the entire root becomes necessary.

If mechanical treatment may seem to offer any hope whatever, it may be obtained in the best manner, by first thoroughly cleansing and drying the fractured parts with alcohol and hot air, and, second, flowing thin, well-mixed cement into the joint. The fractured root then may be brought into close apposition by twisting strong silver suture wire, or copper measurement wire, tight around the entire circumference, and permitting the wire to remain until the cement has crystallized. It then may be removed and a narrow band made of platinum, or gold, fitted carefully to the periphery of the root and cemented permanently.

By this means a secure fixation of the fractured section may obtain,

after which an artificial crown may be constructed, the adaptation of the crown being made over the band previously cemented to the root.

In exceedingly large roots where the line of fracture leaves each segment in nearly equal proportions, what is known as an intradental band may be used instead of a peripheral band.

In the use of an intradental band, the same procedure indicated for using a peripheral band up to and including the twisting of the temporary

Fig. 85.

Fig. 86.

wire is followed. A circular groove of adequate but safe depth is then trephined into both segments of the root (Fig. 85) and an intradental band made of gold, or platinum, then forced to place within the groove.

A very simple set of trephines and exact measurements are used and this procedure affords a secure fixation of the fractured segment within the periphery of the root. The fixation thus obtained may be fortified further and strengthened by the application of an artificial crown having a peripheral band.

Posterior Roots. The same conditions and the same possibilities and limitations apply to the mechanical treatment of the fractured roots of posterior teeth. But, since conservation of the roots is not so important in the posterior teeth as it is in anterior teeth, effort in this direction is justifiable in a much smaller proportion of cases.

Instead of using an intradental band, which is not applicable to posterior roots to the same extent, a similar means of mechanical fixation may

be obtained by undercutting and dovetailing each segment of the fractured root.

This should be done after temporarily sustaining their relation by means of a tightly twisted wire, or with a temporary band fitted closely to the periphery. This counter dovetailed preparation of each segment forms a cavity which then may be filled with amalgam and which, when the amalgam has crystallized, will insure a more or less secure fixation (Fig. 86) after which a permanent crown may be made.

Free Exposure of Basal Surface.

In the preparation of all roots the natural crowns of which are sacrificed, necessarily, to the gingiva and at all times during the construction of dowel crowns of any type, the basal surface should be exposed freely and should be kept exposed freely. The free exposure of the basal surface of the root facilitates its proper preparation, facilitates the requirements of adaptation of the crown and lessens the usual attending discomfort to a very appreciable extent.

These advantages are important and they are to be obtained easily by packing gutta-percha, or temporary stopping, firmly over the basal surface of the root after the remaining natural crown has been sacrificed, and previous to making any attempt to effect the adaptation of the coping and insuring its secure retention.

And, once the root has been prepared, the patient never should be dismissed for any length of time, beyond a few hours, without taking this precaution. The mounting of some form of temporary crown will answer the same purpose.

Aside from the advantages arising from a free exposure of the basal surface of the root and considering the simplicity with which a temporary crown may be made, as well as the embarrassment and disfigurement occasioned by the absence of a missing anterior tooth—a patient for whom a permanent restoration is being made never should be dismissed without some type of temporary crown upon the root.

CHAPTER X.

GOLD TELESCOPE CROWNS.

The gold telescope crown with peripheral band, commonly designated as the "shell" crown, was one of the early achievements in the restoration of the crowns of natural teeth.

As a means of restoration as a single unit, and as a means of affording attachment for bridgework, this type of crown has served the purpose so long and so well that probably a greater number of teeth have been saved and restored to usefulness by it than by any other.

When indicated and when constructed properly and well adapted, the gold telescope crown with a band is a useful means of crown restoration. Being a useful means of restoration, however, does not imply that it is applicable to all teeth at all times.

The adaptability of gold, the indestructibility of a full gold crown and the opportunities for restoring teeth and roots to usefulness, in a manner more or less simple, efficient and permanent, presented advantages which were rapidly recognized. And the recognition was followed quickly by abuse. But the abuse was such as always follows indiscriminate application and failure to observe requirements. Indiscriminate application and failure to observe requirements always must end disastrously; but this should not necessarily condemn the method or principle involved.

Indications. In restoring the crowns of teeth, and in obtaining attachment for bridgework, no one method of procedure is applicable universally, and adaptability and indestructibility are not the only requirements.

The full gold telescope crown possesses several advantageous features and has a place of usefulness, but that does not often embrace application to the restoration of teeth which are within the range of vision.

The restoration of the crowns of teeth, the replacement of missing teeth, the practice of crown and bridgework all are associated with artistic possibilities. To imitate or to simulate nature so closely that detection is difficult, if not impossible, is a fascination of art, but an inharmonious and unnecessary display of gold is an offense to art and violates all traditions of art.

The use of full gold crowns, or the unnecessary display of gold, there-

fore, is contraindicated in the restoration of the teeth within the area of visibility.

Hence, the range of application and the field of usefulness of gold crowns should begin with the molars and should end with the second bicuspids. In rare instances, where the "bite" is abnormally close, where the restoration must be exceedingly short and where the requirements of esthetics must give place to the requirements of indestructibility, the general limitations may be extended to include the first bicuspids: and this will be more often true in the lower jaw. In such cases and under such conditions the application of gold crowns to first bicuspids may be indicated as the best and safest procedure.

Anterior to first bicuspids, however, the use of a gold crown, or the unnecessary display of gold, is an offense to the possibilities of dental art, and to the cultural refinement of the patient. Or, it is an admission of indifference, or an evidence of charlatanism on the part of the dentist.

For these reasons the application and the methods of construction of anterior gold crowns will receive no further consideration.

Requirements. In addition to the abuse following indiscriminate application, the evils of faulty adaptation have much reduced the possible usefulness of the gold telescope crown. This type of crown, or any type of crown involving a telescoping peripheral band, is susceptible to abuse in proportion as the band does or does not fit its supporting tooth or root. Peripheral bands may cover a multitude of sins, and, unquestionably, are often a menace to the health and vitality of the investing tissues unless the requirements of adaptation are observed closely.

If the band is too large, or if it is forced too far beneath the gingival border, both of which are common practices, irritation of the investing tissues must result. Radiographic evidence proves conclusively that a large proportion of gold telescope crowns are thus badly adapted. The use of manufactured or ready-made crowns, or of "seamless" crowns made by dental laboratories, is responsible, largely, for an indifference to the necessity of proper adaptation. But if the requirements of adaptation are observed closely, a peripheral band need not necessarily be a source of irritation.

Any tooth or root which is deserving of restoration by means of an artificial crown of any type is deserving of a restoration which fits. And any tooth, or root, which is capable of affording attachment for bridgework is deserving of an attachment which will not do irreparable injury.

The successful application of full telescope crowns with a peripheral band, therefore, will depend upon an observation of the requirements of

adaptation; and the degree of success will be proportionate to the degree of accuracy obtained.

Full telescope crowns, with a peripheral band, must be sufficiently thick and heavy *when finished* to insure adequate strength and permanency, and must be made of a gold alloy sufficiently high in karat to withstand the chemical action of the oral secretions.

Telescoping portion. The edge of the band which telescopes the end of the root should fit closely around the entire circumference; pass a short, but uniform, distance beneath the gingival border, and possess a smooth, rounding edge, so as to offer no possible irritating influence to the investing tissues. The band itself then should be contoured to typical form; it should restore the points of contact, and preserve a proportionate and symmetrical alinement with the adjacent teeth.

Occlusal surface. The cusp formation of the occlusal surface should mimic or approach a typical reproduction of the particular tooth, restore functional occlusion, and offer no interference to the various excursions of the mandible in the movements of mastication.

The cusps also should be deep and sharp enough to be effective in mastication, and of sufficient thickness to withstand constant and continued attrition. The presentation of a more or less smooth and uncontoured masticating surface precludes the proper mastication of food, and thus diminishes the efficiency.

Methods of Construction. The construction of full telescope crowns with a peripheral band involves two different methods of procedure. One consists, first, in making and fitting the band, and subsequently forming and attaching the cusps, or the occlusal surface, to it. This method is known as the sectional method. The other consists in making the entire crown in one piece and is known as the seamless method.

Sectional Method.

In the sectional method the band and cusps are made separately. This method affords every advantage offered by the seamless method, and embraces a more simplified, technical procedure. It affords opportunity for greater accuracy of adaptation and even better reproduction of contour. It requires less time and permits the use of a heavier gage of gold throughout the construction. These important advantages cause it to be readily accepted as the most universally useful and successful method of construction.

The joint made by the union of band and cusps offers no objectionable feature and in no way interferes with artistic possibilities, provided that the edges are closely approximated, and that the union is made with a

solder resembling closely the color of the crown gold, and sufficiently high in karat to withstand the chemical action of the secretions without subsequent discoloration.

Making the Band. In the procedure incident to the construction of crowns having a peripheral band, the details to be observed embrace first, a true measurement of the circumference of the root and second, making

Fig. 87.

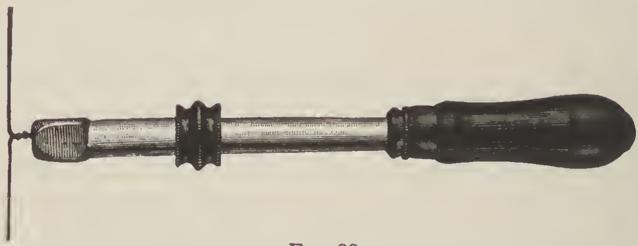


Fig. 88.

the band. A band of accurate dimensions can be secured only from an accurate measurement.

Measurement: Small copper wire, about No. 32, is generally used. A suitable length of wire should be cut, made in circular form, somewhat larger than the root, and the ends securely attached to a small dentimeter. While many varieties of dentimeters may be used, a jewelers' small, slide pin-vise affords the quickest, easiest and most secure adjustment, with less danger of cutting the wire when twisting.

The loop of wire should be carried to place over the tooth, or root, passed just freely beneath the gingival border and twisted taut, being careful in the meantime to conform and adapt it to all concavities. (Fig. 87.)

Where the root is short, or cut down to the gingival line, it may become necessary to hold it in position with a suitable instrument, in order to prevent any displacement of the wire while twisting. Usually it is most convenient to twist from the buccal surface; but on second and third molars, it sometimes may be found more convenient to twist from the lingual surface.

After thus securing the correct measurement of the circumference of the tooth, or root, the wire should be cut in two at a point farthest away from the twisted end, and each end of the former loop carefully straightened out until smooth, continuous and at right angles with the dentimeter. (Fig. 88.)

When two or more crowns are being constructed at the same time, and especially when the roots are nearly of the same size, each measure-

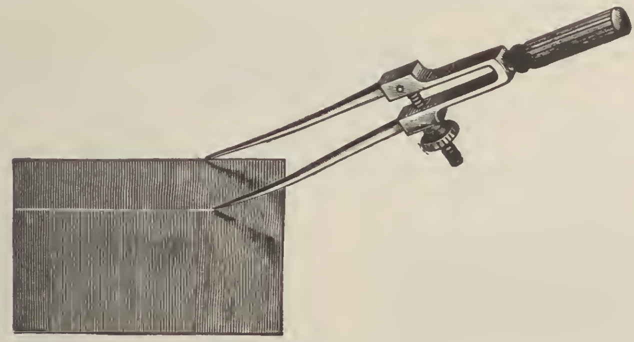


FIG. 89.

ment should be given some characteristic bend or twist, in order to distinguish one from the other. By this means any confusion in the subsequent fitting of the bands may be avoided.

The strength possessed by the finished crown, in its attachment to the root, increases in proportion to the thickness of the gold plate of which the band is made. As gold stretches easily, and since its thickness is diminished necessarily to a certain degree by subsequent finishing and polishing, plate gold, not thinner than 28 gage nor less than 22 karat in fineness, should always be used for bands. As thin as 29, or even 30 gage gold plate may be used, but 28 gage retains its shape better and admits of greater freedom in finishing.

Width: The desired width of the band should be noted with the eye, or, if necessary, measured with a piece of cardboard trimmed to the correct width; or with a small pair of calipers. (Fig. 89.)

Length: The band should always be cut with the grain of the metal, and the cervical edge, or that edge which is to be fitted to the tooth, or root, should be cut to approximate the exact length of the measurement wire. Any great variation between the circumference of the root and the dimensions of the space to be filled by the crown may require that one edge of the band be cut on such an angle as to make a difference

between the circumference of its cervical and occlusal edges when soldered. (Fig. 90.)

Perfectly straight edges usually will afford sufficient opportunity for obtaining the necessary contouring of the occlusal edge of the band, but

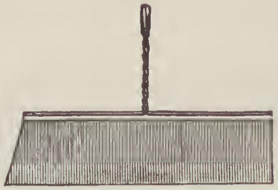


Fig. 90.

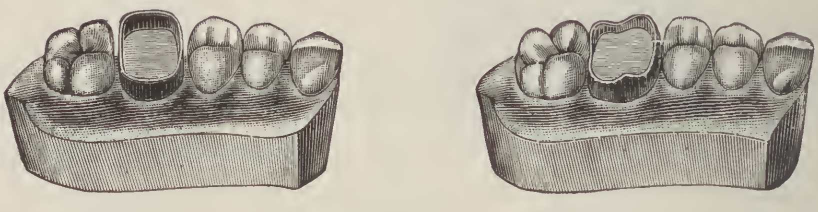


Fig. 91.

frequently it is desirable and sometimes even necessary to have this edge of slightly larger proportions, especially in bicuspids, in order to meet more perfectly the requirements of contact and alinement.

Where the circumference of the root is greater than the space to be filled—a condition which is usually caused by the migration of the adjacent teeth—the converse may be indicated in order to secure and preserve the buccal and lingual alinement of the occlusal surfaces. In such instances the edges should be cut straight to facilitate the adaptation to the root. The circumference of the occlusal edge may then be reduced adequately as illustrated in Fig. 91.

Cone-shaped Bands. Where the maximum circumference of the root, properly prepared, is much less than that of the space which the crown must fill, or where an exaggerated contour is required to meet the demands of contact and alinement, a cone-shaped band may be made by cutting the gold on a curve, as indicated in Fig. 92.

Soldering the Band. When the band has been cut properly, it should be annealed by heating to a cherry-red and plunging into alcohol or water.

The edges, then, should be made true and smooth, so as to approximate evenly when brought into contact, and the band made into circular form. Contact between the edges is essential to insure accurate size, and to facilitate soldering. This contact may be sustained by overlapping the

FIG. 92.

FIG. 93.

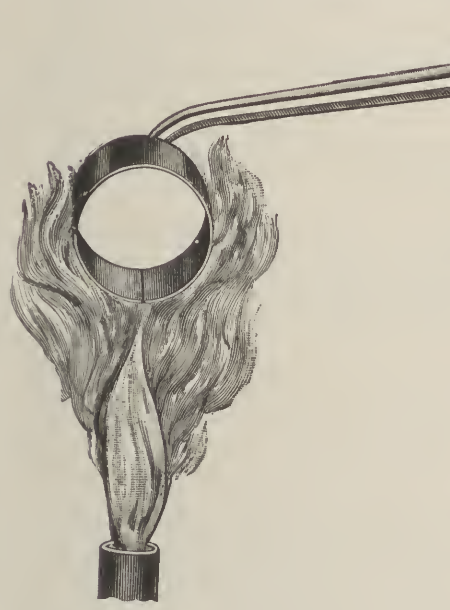


FIG. 94.

edges first (Fig. 93), and then bringing them back into direct contact. This procedure condenses the molecules sufficiently to overcome expansion, which, otherwise, would cause a separation when heated. It is preferable to wiring the outside circumference of the bands, because the solder frequently penetrates the joint and attaches the wire to the gold, necessitating its being ground off afterwards.

When the edges have been approximated thus, the band should be grasped with fine-pointed pliers at a point as remote from the joint as possible, so that the pliers absorb but little heat. (Fig. 94.) Flux should be applied, carried to the flame and fused. A very small piece of solder should then be fluxed and placed immediately over the joint.

In soldering, the band should be held in the flame in such manner as to heat both edges uniformly. If either edge should receive a greater degree of heat than the other, the solder would become attached to it,

and the addition of a second piece made necessary. The use of more solder than is required to make the joint is objectionable because of additional stiffness thus imparted to the band.

Fig. 95.

To prevent subsequent refusing, and to admit of finishing with solder of as high karat as possible, all bands should be soldered with 22 karat solder. Lower than 20 karat never should be used.

For convenience and comfort, the pliers used for soldering bands should possess a long handle and thin, tapering points. (Fig. 95.) The soldering may be accomplished easily and quickly by holding the band over an ordinary Bunsen flame.

Fitting. Fitting the band to the tooth, or root, may be made with facility and accuracy and without great discomfort if it is shaped previously to conform to the root and its surrounding tissues before any attempt is made to adjust it. The requirements which should be observed in this connection, in detail, are as follows:

First: The band should be conformed to the general shape and outline of the root before any attempt at fitting is made.

Second: The edge of the band which is to pass slightly within the gingival border must be trimmed to follow closely the outlines of the gingival curvature, in order that this edge will come in contact with the investing tissues evenly and uniformly at all points, before the final pressure is applied.

Third: The edge must be round and smooth in order that no unnecessary irritation will be offered.

Fourth: For convenience and to avoid any confusion in adjusting and readjusting bands, and because the usual convexity of roots at this point facilitates the adaptation of the stiffened portion of the band, and because of placing the soldered joint where it will be least conspicuous in case of subsequent discoloration, as well as being most easily accessible for reinforcement in the assemblage of bridgework, the joint should always be placed at the center of the lingual surface of the root.

To overlook or neglect any of these essential features adds to the difficulties incident to fitting bands and to the degree of discomfort occasioned by the procedure. In ob-

serving these features the band should be placed gently over the tooth, or root, first, and then shaped with pliers until it is made to conform to the general outline, and to any existing concavities or inequalities.

Gingival Edge. The gingival edge then should be trimmed carefully with curved pointed shears (Fig. 96) until it meets the gingival line evenly at all points. Then it should be rounded nicely from the outer surface with a fine half-round file until blunt and smooth. The possibility of irritation is thus overcome without any appreciable loss of thickness of gold.

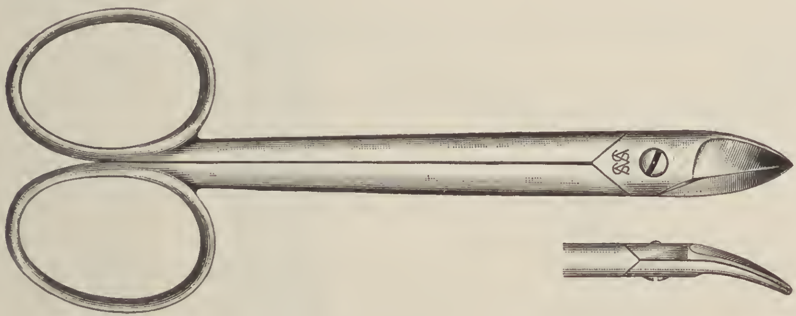


Fig. 96.

When these requirements have been met the band should be placed upon the tooth or root, and gently pressed to place until the edge passes just beneath the gingiva. For this purpose, a small piece of wood of convenient size, with flat, smooth surfaces, is most useful. If used properly, a small piece of wood greatly facilitates the procedure and overcomes any necessity for using more force, or for *driving* the band to place. This latter procedure is entirely unnecessary, even brutal, and should always be avoided.

In instances where a normal, healthy recession of the gingiva may have exposed the root beyond the normal outlines at some point, which condition is found frequently, a separate extension of the band may be indicated in preference to trimming it upon all other surfaces sufficiently to admit of contact with the gingiva at this particular point.

This may be accomplished: First, by fitting the band accurately without regard to this extension, after which a small piece of pure gold plate may be tacked first, with solder, to the outer surface of the band, and then trimmed and burnished until the exposed portion of the root is covered. When the desired outline and adaptation have been obtained it may be sustained permanently by reenforcing the extension with a high grade solder.

When the cervical adaptation of the band has been completed, the occlusal edge should be trimmed to afford accommodation for the adjustment of cusps of uniform and sufficient thickness.

Occlusal Edge. In trimming the occlusal edge of the band, two methods of procedure are followed. The first and preferable procedure consists in allowing the full band to remain as long as possible and trimming its entire occlusal edge until it is just clear of contact with the opposing natural teeth. (Fig. 97.)

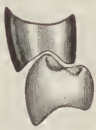


Fig. 97.

Fig. 98.

This procedure brings the immediate joint between band and cusps at the occlusal angle and provision for the thickness of the cusps must be made, of course, from the inside, and at the expense of the occlusal end of the supporting tooth.

If such provision is made, this is the logical point for the joint. Placing the joint at this point affords every opportunity for the artistic reproduction of tooth form by contouring, and carries the line of solder to a point where subsequent discoloration will not be in evidence.

Contouring. The entire artistic effect of the finished crown, as well as an observation of the requirements of contact and alinement depend in a great measure upon the form and shape given to the occlusal edge of the band.

By contouring is meant the reproduction of the natural form and outline of the tooth. Artistic results are made possible only by a thorough knowledge of the surface angles and general form of the crowns of

natural teeth, the outlines of which should be reproduced in this edge of the band. This may be done, irrespective of the necessary form assumed by the cervical edge, and without change of it.

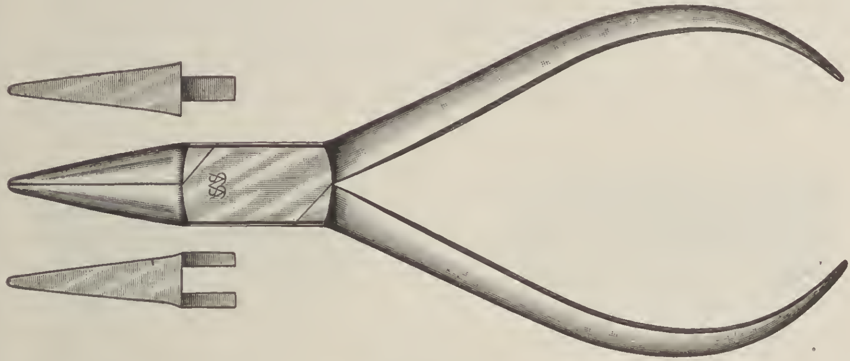


Fig. 99.

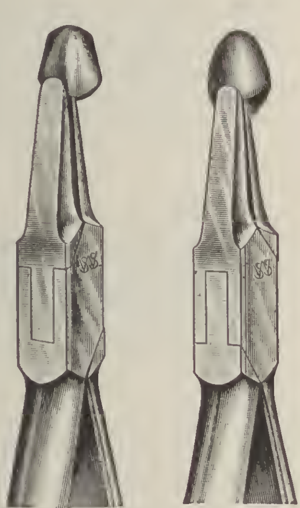


Fig. 100.

Fig. 101.

For contouring purposes, various styles and designs of pliers are used, but only a few are needed. All of the artistic results necessary may be accomplished easily with two pairs of pliers. These are known as "hawk-bill" and "straight-nose" pliers. The hawk-bill pliers are particularly adapted to contouring the buccal and lingual surfaces of bands where some expansion of the central portion is desired. (Fig. 98.) Straight-nose pliers which have beaks which come together closely and

which possess rounded edges (Fig. 99) are useful in producing angles and ridges and in contracting the edges as illustrated in Fig. 100.

The full possibilities of contouring as applied to bicuspid and molar bands trimmed to the occlusal angle is illustrated in Fig. 101.

The other and second method of procedure which probably is used more generally, consists in trimming the occlusal edge of the band to allow for the full thickness of the cusps. This method places the joint

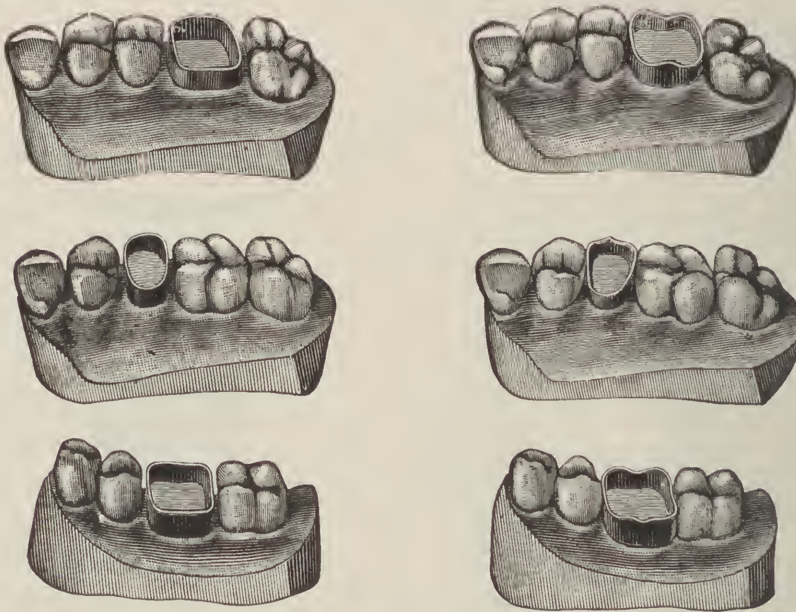


Fig. 102.

between band and cusps at a point where any discoloration of the solder will be visible, but, otherwise, affords the same artistic possibilities.

The typical results possible in this method of procedure and which are obtained from a knowledge of the form and outlines of the teeth, and from a skilful manipulation of the pliers, are illustrated before and after contouring the band in Fig. 102.

In instances where the size of the supporting tooth, or root, after being prepared properly, is larger than the dimensions of the occlusal surfaces of the adjacent natural crowns, it may become necessary to reduce the circumference of the occlusal edge of the band to secure a symmetrical alinement.

This reduction may be accomplished easily by cutting numerous slits

around the approximal and lingual surfaces of the occlusal edge and then drawing in the flaps thus made, overlapping them until the circumference is reduced sufficiently, as illustrated previously in Fig. 91. These slits will be filled with solder and a smooth, uninterrupted surface will present.

When the desired requirements of contour of the band have been obtained by either method, the details incident to the production of the cusps or the formation of the occlusal surface follows.

Forming the Cusps.

Several different methods of procedure are followed in the formation of the occlusal surfaces. These methods include swaging and casting and are so numerous as to make a selection of the one universally best method practically impossible.

The simplest and most accurate occlusal surfaces are undoubtedly obtained by transferring the band from the mouth to the laboratory by means of an impression and cast.

Impressions and Casts. When the details of occlusal surface formation are to be transferred to the laboratory, the interior of the band, in position on the supporting tooth or root, should be filled first flush with its edge with wax, or temporary stopping. This precaution facilitates the taking of the bite, and its subsequent adjustment to the cast.

Bite. The bite always should be taken previous to taking the impression, because the imprint of the band is necessary to admit of its adjustment to the cast having the band in place. Ordinary pink baseplate wax is preferable for this purpose, because of the facility with which a good imprint of the teeth may be secured, and because of its more easy and accurate adjustment to the cast.

In obtaining the bite, sufficient wax should be used to secure the imprint of several teeth on each side of the crown. And, in the procedure, it should be ascertained definitely that the teeth are in centric occlusion. When a proper relationship is obtained the patient then should be instructed to close firmly and to press the wax against the lingual surfaces of the teeth with the tongue. By compressing it closely to the buccal surfaces with the fingers at the same time, a well-defined bite is obtained readily.

Impression. The impression always should be taken with plaster and, corresponding with the bite, should include several teeth on each side of the crown. This is necessary in order to prove the bite and to sustain the correct relationship when mounted upon the articulator.

The use of plaster for the impression is essential because of the difficulty of, and the uncertainty in, adjusting the band to its accurate position in the impression when any material is used which draws in removing. This very important procedure may be accomplished with a degree of absolute certainty when plaster is used.

FIG. 103.

Because of the natural form of the crowns of teeth it will be necessary to fracture the plaster impression in removing it. Accuracy is insured by fracturing. The fractured pieces must be reclaimed, however, and must be large enough to be replaced accurately and the replacement sustained securely with hard wax.

When the parts are replaced accurately and their relationship sustained securely, the impression should be varnished, filled, separated, the bite adjusted, and then mounted securely upon the articulator.

Originally the occlusal surface of gold crowns was formed by soldering a flat surface of gold plate to the occlusal edge of the band and the cusps were constructed with small globules of scrap gold, or with pieces of triangular irridio-platinum, or clasp-metal wire, attached with solder. The desired form was obtained subsequently by grinding.

Die and Die-plate Methods.

While many of these crude, inaccurate and inartistic efforts were successful from the standpoint of usefulness, a desire for more artistic results led to the introduction of dies and the process of swaging.

Individual Dies. The first efforts in the direction of dies were made in the form of individual dies obtained from extracted teeth Suitable teeth were selected and mounted in a plaster base, trimmed to favorable shape. A mold was made in sand and a casting made of zinc. (Fig. 103.)

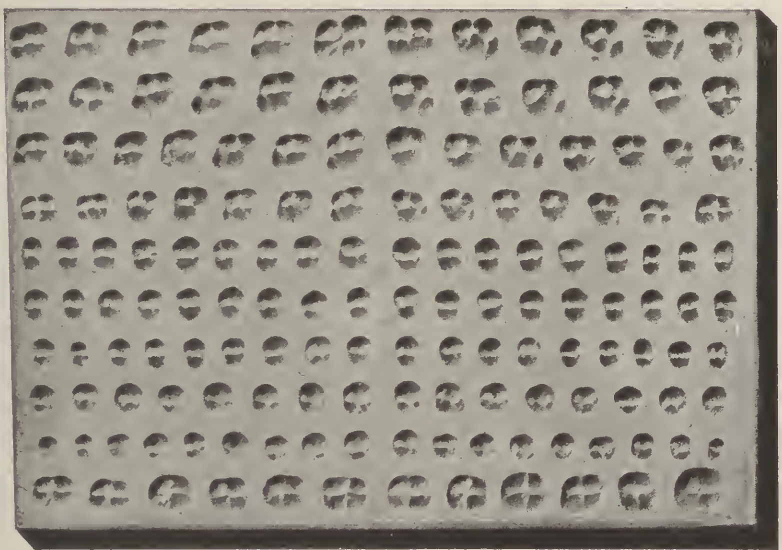


Fig. 104.

Plate gold was swaged to conform to the outlines of the natural cusps by driving the zinc die into a smooth surface of lead, or tin, or an old, discarded counter-die. This method was productive of such a degree of improvement over the former procedure as to cause the manufacturers to make dies of brass. They were made in sets including various sizes and forms.

Die-plates. Because of the immediate necessity for a suitable counter-die to take the place of the block of lead or tin, the introduction of the die-plate followed.

Die-plates comprise various numbers of cusp-molds grouped in a brass or steel casting. (Fig. 104.) In their use, swaging is accomplished easily and quickly by driving a disk of plate gold, of suitable size and thickness, into the mold selected, with an ingot of lead or of an alloy of lead and tin. Ordinary buckshot, size No. 1 or No. 2, answer the purpose nicely. Die-plates made of steel may be used thus, or may be used to form solid cusps by driving an ingot of gold directly into the mold selected.

These die-plates are to-day in common use. Their usefulness and their range of application increases in proportion to the number and variety of cusp-forms embraced, and their limitations decrease accordingly.

Use of Die-Plates. In the use of die-plates, the mold should be selected which best represents the individual tooth to be crowned, and which approximates the size of the band. The requirements of occlusion must be observed in the fitting and adjustment of the swaged cusp-form to the band. This can be done only after swaging.

Adjusting Swaged Cusps to Casts. Swaged cusp formed by any die-plate system or method can be fitted and adjusted best to the requirements of occlusion by obtaining the relationship with casts mounted upon the articulator. Opportunity is thus afforded for trimming the band, or the swaged cusps, or both, until their approximation, together with a favorable occlusion, obtains. By this means accuracy can be noted upon the lingual, as well as upon the buccal surfaces.

The requirements of occlusion may be obtained and perfected by depressing or expanding the cusps, using a blunt instrument or a piece of hard wood for the purpose. When the requirements have been met, an effort should be made to approximate closely the edge of the swaged cusps to the band. A close approximation may be made by bending the edge of one or the other with pliers. Care must be exercised not to distort the shape of the band, nor destroy its contact and alinement.

As a final means of perfectly meeting the requirements of occlusion, and of proving that accuracy obtains, it is good practice to attach band and cusps, first, with a minimum of solder, and then place the crown in position on its supporting tooth or root, in the mouth.

Owing to the temporary thinness of the cusps at this time, they may be made to meet all the requirements of functional occlusion, more perfectly, by having the patient bite firmly and in every direction. When the desired accuracy has been obtained thus, the cusps then may be reinforced adequately with solder.

Adjusting Cusps Without Casts. Where it may be desirable to construct the crown without an impression, or a cast, and to make the adjustment directly in the mouth, the cusps should be swaged, adapted to the edge of the band and band and cusps attached. The crown then may be placed in position on the supporting tooth, or root, and the opposing teeth closed into it firmly. The soldering may be completed, then, and the necessary reinforcement made. In cases where the requirements are particularly difficult, this process may be facilitated further by swaging the cusps of 28 or 30 gage pure gold. Pure gold, of this thickness, is

so much more yielding than 22 karat gold that but little resistance to the closure of the teeth into firm occlusion will be offered, and accurate results will be insured.

But cusps made of pure gold should be attached and reinforced with a very high grade of solder, because the extreme softness will result shortly in wear and the exposure of the solder.

Making Special Dies.

Of the various methods for securing suitable cusp forms, or reproductions of the occlusal surface outlines which will typify the natural teeth, and meet the requirements of occlusion, by *swaging,* but *one* general line of procedure offers absolute certainty and accuracy in all cases.

Throughout the entire evolution of methods for procuring cusp reproductions, some "system" of typical dies was in general use until the casting process, offering greater possibilities, became the better practice.

In the construction of crowns of this type, the conditions presenting vary in proportion to the degree of the accuracy of occlusion, to the position of the tooth, or root, and its relation to the adjacent teeth, and in the length and shape of the band and the depth of cusps required. Hence, a ready-made form which will approximate closely the edge of a properly-contoured band and occlude accurately with the opposing teeth is not always a reasonable expectation.

If the requirements are to be observed, and the swaging method is to be used, the demands of certainty and accuracy are to be obtained in the best manner by making an original carving from an imprint of the opposing teeth. A special die then may be made from this carving. This procedure probably may require more time than other methods, but time should not always be the only factor to be considered.

Dies and Counter Dies. Dies are made for the purpose of conforming gold plate of suitable thickness to the outlines of the surfaces desired and thus reproduced.

The original reproduction of surface outlines is known as the "die" and is made, usually, of an alloy which will withstand stress without appreciable change of form, and without being defaced easily. When the die has been made a counter-die is obtained by pouring a lower-fusing and somewhat softer metal, or alloy, directly upon it.

For larger work, zinc, or Babbitt metal, is used for the die. Both are moderately low-fusing and present dense, hard surfaces. The counter-die is made usually of tin, or lead, or of an alloy of these two metals.

In pouring the softer and lower-fusing counter-die, the metal, or

alloy, used must not be overheated in melting and must be poured when cool, or poured just before it begins to congeal in cooling. This precaution is necessary as a means of preventing adhesion between die and counter-die by fusion. Coating the surface of the die with whiting,

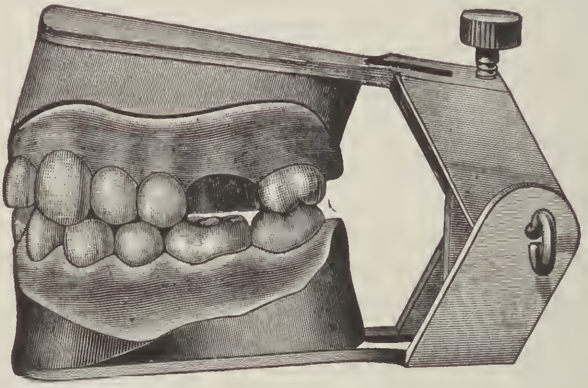


Fig. 105.

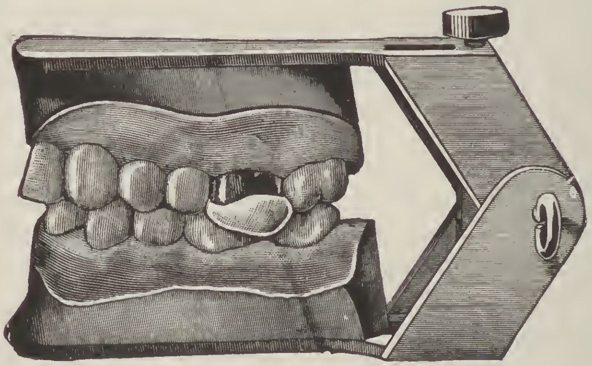


Fig. 106.

mixed with alcohol, just previous to pouring the counter-die is useful as a further and supplementary precaution.

The counter-die usually should be made of a metal, or alloy, softer in character than that of which the die is made, as well as being lower in fusibility. The use of a softer metal, or alloy, for the counter-die presents an advantage because it offers less resistance and yields more readily in swaging. By yielding more readily, the gold being swaged is less likely to be torn or stretched.

But for small work, such as the swaging of cusps, the die and counter-die both may be made with fusible alloy. Two different alloys, one of higher fusibility than the other, would be less likely to become attached to each other in pouring one upon the other; but the use of two different alloys is unnecessary if the precautions indicated are taken.

Dies made of fusible alloys may be obtained in a very simple manner by pouring directly into a mold made in moldine. Moldine is composed of potters' clay and glycerin. The lower-fusing fusible alloys may be poured directly into plaster impressions, or into compound impressions.

Fig. 107.

Fig. 108.

Carved Cusps and Special Dies. The technical procedure involved in carving special cusps and in making special dies requires the taking of a bite and impression, and the making of casts.

When the cast, with band in place, has been mounted upon the articulator (Fig. 105), all surfaces of plaster in close proximity with the band should be varnished with collodion, sandarac, or liquid silex. The band now should be filled with thin, well-mixed plaster, into which the occlusal surfaces of the opposing teeth are imprinted by closing the articulator firmly. (Fig. 106.)

The accurate reproduction on the cast, of the teeth adjacent to the band, serves to sustain and prove the proper relationship. When the plaster in the band has crystallized, the articulator should be opened and the band, with its plaster contents, detached from the cast in a manner which will preserve its definite outline and relationship. The surplus plaster around the outer edge of the band should be removed first with a small, sharp carving instrument. This leaves the plaster remaining within the band somewhat crude and irregular in surface outline, but accurate in so far as concerns occlusion. (Fig. 107.)

Artistic results in proportion to the degree of skill possessed by the operator may now be obtained by carving and reproducing the typical outlines of the natural tooth crown. This may be done without destroying the points of contact which insure accuracy of occlusion. (Fig. 108.)

Impression compound and certain special forms of hard wax are used also instead of plaster. The use of any of these compounds, however, is not so reliable as plaster because of the tendency to flake or chip in carving, and because of their susceptibility to change of form in the subsequent process of securing the mold for the die.

FIG. 109.

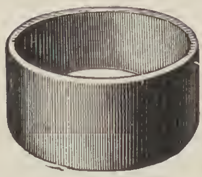


FIG. 110.

In carving it is not altogether necessary that absolutely correct anatomical outlines should be reproduced. Nevertheless, the masticatory purposes of cusps, inclined planes, ridges and sulci should be thoroughly understood and the fundamental principles thereof should be observed in producing the artificial occlusal surface. Moreover, the age of the patient and the contour of the natural teeth, which have resulted from wear, should be the guide. Fig. 109 shows such compromise carving.

The most generally useful and the simplest method of making special dies is known as the direct method. In this procedure, the band, with its plaster cusps, is imbedded in a metal ring (Fig. 110), filled flush with its edge, with moldine, with *cervical end down,* until only the plaster cusps are exposed, and exposed even with edge of band. The rubber ring, which is a part of moldine "outfits," is then placed over this (Fig. 111), and fusible metal poured directly against the plaster cusps, thus forming a fusible metal mold, or what is known as a counter-die. The cusps now may be swaged into this by using No. 1 or No. 2 buckshot, or ingots, or swaging plugs made of tin and lead. (Fig. 112.)

Fusible alloy "outfits" are made for this and for other similar purposes. They include moldine and both metal and rubber rings.

In melting, the fusible alloy should never be overheated. And in the making of dies for any purpose it should be poured just before it begins to congeal. In pouring the fusible alloy directly upon the plaster

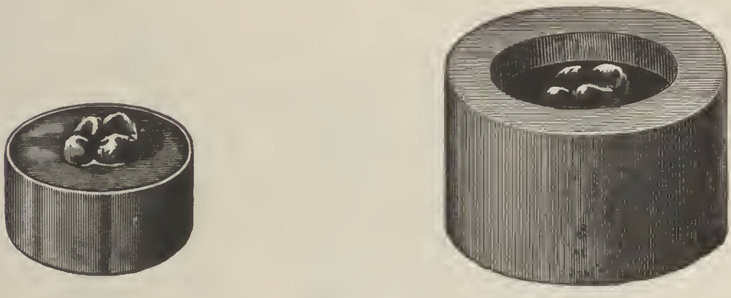


FIG. 111.

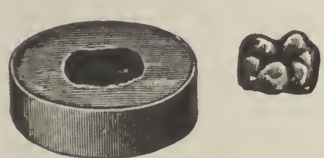


FIG. 112.

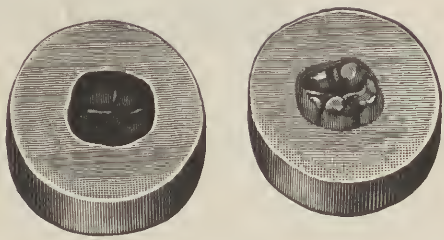


FIG. 113.

cusps a smoothness of surface will result if the plaster is thoroughly dry. This precaution should be taken always.

In the absence of suitable swaging slugs, or ingots, a die made of the same fusible alloy may be obtained by lightly coating the surface of the original counter-die with whiting, mixed with alcohol, adjusting the rubber ring and pouring directly upon it. The two may be separated easily, provided that the fusible alloy is not poured when too hot. This procedure affords a die and counter-die of the same alloy. (Fig. 113.)

Swaging.

Swaging is the process of adapting or conforming plate gold, or other metals or alloys, to the outlines of the surface of the die.

In the process of swaging, the surfaces of the dies should be *oiled*. This facilitates the procedure and prevents the gold from adhering to the

dies. Defacing the gold is to be prevented by stretching a piece of rubber dam over it before driving it into the counter-die. This precaution also prevents any small flakes of die metal from adhering to the surface of the gold. Any danger of tearing the gold may be reduced to a minimum by swaging first, between the dies, a few layers of heavy tin foil, covered with rubber dam.

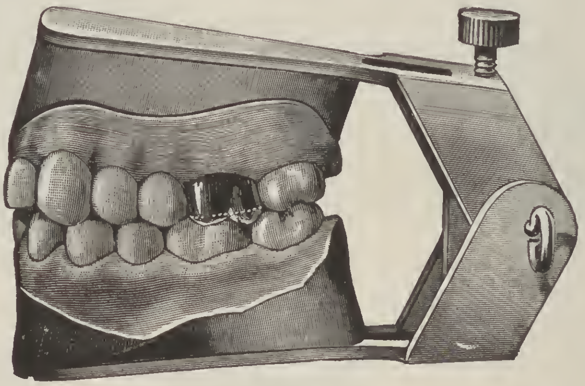


Fig. 114.

The gold, used for swaging cusps, should be of the same karat and color as the gold used for the band, and should be of 28 gage thickness, although 29 gage, and even 30 gage, is used. A disk, somewhat larger than the diameter of the cusps to be formed, should be cut and should be annealed frequently during the swaging process. A round or disk-shaped piece of plate gold will yield more readily to the swaging process, and will have less tendency to overlap at the angles. All unnecessary surplus should be removed before the final swaging. Steady and uniform pressure, such as will result from the use of a press of adequate power, probably is the best means of swaging. In the absence of a press a heavy hammer and a few well-directed blows will answer the purpose.

Adjusting Cusps to Band.

When the swaging of the cusps, made by *any* method, has been completed and when all surplus gold has been trimmed away, the edge of the cusps should be adjusted carefully to proper relationship and contact with the band.

The final trimming should be done with a fine, flat-surface gold file, and may be best accomplished by holding the file steady and carrying the

cusps backward and forward over its flat surface. When trimmed thus, until the edge approximates evenly with the edge of the band, and the desired occlusion obtains upon closure of the articulator (Fig. 114), the cusps should be soldered to the band.

Soldering. All necessary reenforcement of the cusps sufficient to withstand constant and continued attrition may be made with solder simultaneously with the attachment of the cusps to the band. Filling the cusps with solder previous to their final attachment to the band facilitates the soldering.

FIG. 115.

During the process of soldering, the relationship between cusps and band should be sustained securely. This is to be accomplished best by using automatic soldering pliers designed for the purpose, as illustrated in Fig. 115. Wiring cusps to the band is objectionable for the same reasons previously mentioned in connection with soldering the band.

Before soldering, both the band and the cusps should be treated to the acid bath and then washed freely with water. When adjusted in the pliers, flux should be applied and fused and the parts then united with 22 or 20 karat solder. The necessary reenforcement should be made with the same karat solder. Any perforation resulting from swaging should be filled first with plate or foil gold, by which means no trouble will be experienced in filling in with solder.

Finishing. When the soldering has been completed, the crown should be treated again to the acid bath to dissolve remaining borax. It should be finished down with carborundum stones and disks and polished.

Seamless Method.

The seamless method of constructing gold telescope crowns involves the formation of the entire crown with a single piece of gold, through swaging. While many "systems" have been devised for this particular style of construction, a close observation of the relative advantages, compared with the sectional method, fails to afford any real or practical evi-

dence of special merit in this process. Therefore, it is to be regarded as an obsolete method, and as one affording no advantages over a manufactured or ready-made crown.

Gold Crowns Applied to Separated Molar Roots.

Where the roots of molar teeth have become separated at the bifurcation as the result of extensive disintegration of the natural crown, and where each individual root remains healthy and firm in its attachment, the application of a gold crown may be indicated. At times a crown will not only restore the separated roots to their former usefulness, but also will

FIG. 116.

preclude impaired occlusion of the adjacent teeth, as a result of migration following the loss of such roots.

The retention of the roots of the first permanent molars, particularly during early life, by any adequate method of restoration is an important consideration.

When retention is indicated and restoration is demanded, the individual roots should be prepared carefully and each root built up separately with amalgam (anchored with a post, or anchored by other means of mechanical retention) until it presents a shape suitable for the permanent attachment of a separate band. (Fig. 116.)

Separate bands should be fitted to each root, the occlusal ends trimmed to allow for cusps, and contoured to approximate each other, and to restore contact with adjacent teeth.

A bite in wax and an impression in plaster should be obtained, and the casts mounted upon the articulator. When the articulator has been separated the bands should be detached from the cast in such manner as to preserve their outlines and admit of accurate replacement. They should be readjusted to position on the cast and united securely with hard wax. After this, the bands are removed, and the cervical half imbedded in investment material. Their relationship is then permanently sustained with 22 karat solder. Uniting the occlusal ends, only, will leave a free, clean, interproximal space. (Fig. 117.)

Following this, the united bands should be replaced upon the cast and the cusps formed by any method desired, and formed as though for a single band.

In attaching bands to cusps, however, care must be exercised to prevent refusing the solder with which the bands were united previously, thus destroying the relationship between them. The use of a lower karat

FIG. 117.

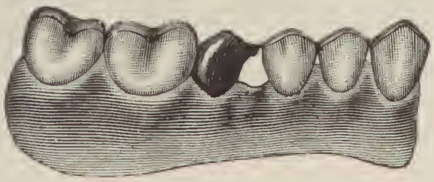


FIG. 118.

of solder will preclude such a mishap, and to facilitate the procedure further, the cusps should be filled with solder immediately following their proper adaptation and adjustment, and previous to attaching them to the bands. The use of an anti-flux (whiting and alcohol) is a precaution, also, which it is well to observe.

Restoring Single Roots of Molar Teeth.

A single molar root which possesses sufficient strength to warrant retention and restoration often may be retained and made serviceable by the application of a gold crown.

The occlusal surface of a gold crown, supported by a single root, may be made to afford a continuous masticating surface by extending it mesially, or distally, until it effects approximal contact with the crown of the adjacent natural tooth. (Fig. 118.) The contact point between the crown and the adjacent natural tooth, however, should be sufficient only to prevent any tipping of the root from the stresses of occlusion. And, for prophylactic reasons, it should rest closely to the occlusal surface and be smooth and well rounded.

Gold Crowns Acting as Cantilever Bridges.

Small intervening spaces between two gold crowns may be bridged over by the crowns in such manner as to afford an uninterrupted masticating surface. (Fig. 119.) This type of restoration might be indicated and warrantable in cases where a very small space existed; but, where the space is sufficiently large to accommodate a properly formed pontic, an assembled bridge would be the better procedure.

Fig. 119.

Open-Face Crowns.

A type of partial crown with telescoping peripheral band, used as a means of obtaining attachment for bridgework, and used much more often than it should be, is known as an "open-face" crown.

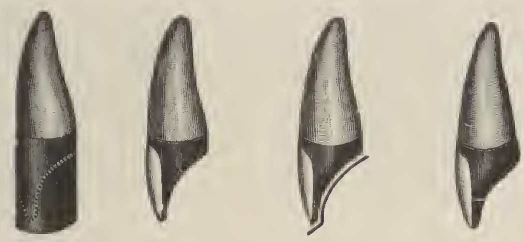
This type of crown has a limited field of usefulness. It is better than a full gold crown, only because less gold is displayed. And it is better than some other methods of attachment to the crowns of natural teeth for the anchorage of bridgework, only because in its application less mutilation of the natural tooth crown is necessary.

A favorable degree of strength in the attachment to the supporting tooth, with a minimum of mutilation of natural crown are the chief assets of the open-face crown. But these assets obtain at the expense of esthetics.

Indications. In cases where the requirements of esthetics must give place to the requirements of strength, and in cases where the age of the patient, or the stability of the tooth, or other reasons which do not warrant a more extensive preparation of the natural crown are present, the application of an open-face crown may be indicated as being the simplest means of obtaining attachment for bridgework—especially when the attachment is to be made to the cuspid teeth.

The natural shape of the crowns of the cuspid teeth is favorable to a more or less accurate adaptation of the open-face crown without extensive preparation. With rare exceptions, its application should be confined to these teeth.

Construction. In the construction of an open-face crown, when the supporting natural crown has been prepared properly, a wire measurement should be taken and a wide band made of 28 gage, 22 karat gold. The band should be wider than the full length of the natural crown, and its edges should be cut straight, and soldered with 22 karat solder.



A B C D

Fig. 120.

The gingival edge then should be trimmed to follow the gingival curvature and made blunt and smooth. The band now should be forced to place on the supporting tooth until this edge passes just within the gingival border. (Fig. 120 A.) The labial portion then should be trimmed away until only a narrow band presents around the labiogingival border, after which the lingual surface is cut away at the mesiolingual and distolingual angles. (Fig. 120 B.) This will form a band exposing both labial and lingual surfaces of the natural crown, but covering the mesial and distal surfaces to the incisal angle.

A separate piece of plate gold of the same thickness and karat, but with some surplus, then should be shaped to conform to the lingual curvature of the band (Fig 120 C), and then attached to this edge of the band with 22 karat or 20 karat solder. After soldering, all surplus should be trimmed away until a smooth and continuous surface presents. The crown should then be placed in position on the supporting natural crown and the final adaptation completed by burnishing. (Fig. 120 D.)

Pure gold, 28 gage, or even 30 gage, may be used to form the lingual surface, and its use will afford increased opportunity for obtaining accuracy of adaptation to this surface of the natural crown. Where pure gold is used, however, it must be reinforced adequately with a high grade of solder, after the burnishing has been completed.

Manufactured or Ready-made Gold Crowns.

Manufactured or ready-made seamless gold crowns are procurable in a large variety of sizes and typical forms for bicuspids and molars. They are made of 30 gage, 22 karat gold.

In the use of ready-made gold crowns, a measurement is taken and a size of crown approximating the size of the tooth to be restored is selected. In effecting the adaptation, the gingival edge is trimmed gradually until a length which will accommodate the requirements of occlusion obtains. Restoration of contact and preservation of alinement with adjacent natural teeth is observed thereafter, and gingival adaptation is made as accurate as possible by the use of contouring pliers. The occlusal surface then should be reinforced adequately with solder.

If any degree of accuracy is secured, the time required to adapt a ready-made crown properly to all requirements will usually equal, if not exceed, the time required to construct one for the case. And the results will be much less satisfactory.

Application of Casting Process.

With the advent and successful application of the casting process, the construction of crown and bridgework was revolutionized, and many former methods of procedure abandoned.

In the construction of gold crowns, the use of dies and of die-plates becomes unnecessary, and swaging is resorted to only as a supplementary procedure. All of the combined advantages of the sectional and seamless crown methods may be obtained, and better adaptation and more definite and more artistic results are made possible.

In its application, the band may be long or it may be short. It may be trimmed to allow for the full thickness of cusps, or it may be trimmed to be just free of the occlusal planes of the opposing teeth. Or no band at all may be used. And the technical procedure of construction may be conducted upon the tooth or root in the mouth directly, or it may be transferred to the laboratory and done on casts.

Two general lines of procedure are followed. These may be designated as the direct and as the indirect methods. Each has its advantages and its respective field of application and usefulness.

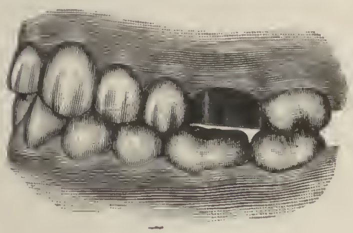
Direct Method.

In the application of the direct method to the construction of gold crowns, the casting process involves the formation of the cusps only, and the details of procedure are applied to the mouth directly. This eliminates

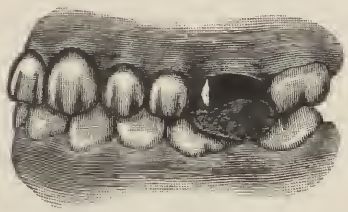
the taking of impression, the making of casts, the use of dies or die-plates, and swaging.

Wherever the direct method may be followed, much time is saved, and, since no reproduction is as accurate as the original, even greater accuracy is possible, in proportion as correct technic may be developed.

Telescoping Peripheral Band. The simplest method of forming the cusps by the casting process involves the making and fitting of a wide peripheral band, the formation of the cusps in casting wax, directly



A



B

Fig. 121.

on the supporting tooth, or root, in the mouth, and their reproduction in gold by casting directly to the band.

Although physical union between band and cusps does not result, or is not insured, all requirements of adaptation are satisfied and complete physical union may be insured by the use of a very small bit of solder, after the casting has been completed.

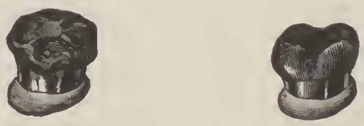
The band should be made of 28 gage, 22 karat gold plate and trimmed, fitted and contoured to meet all requirements indicated for swaged cusps.

When these requirements have been met, the band should be placed in position on the supporting tooth in the mouth (Fig. 121 A), and casting wax of proportions just sufficient to fill it completely and to accommodate an imprint of the opposing teeth, should be made plastic by immersing it in hot water. It then should be pressed firmly to place inside of the band. The opposing teeth should be closed compactly into the wax and all the varying movements of functional occlusion observed while the wax is still plastic. (Fig. 121 B.) This latter precaution is exceedingly necessary as a means of insuring an accommodation for all movements of occlusion in the finished crown, after casting.

Casting Wax. In the use of casting wax for this purpose, the best results are obtained always, by heating the wax in hot water. The temperature of the water should be just sufficient to insure uniform plasticity, without destroying integrity. If overheated, it will not offer resistance,

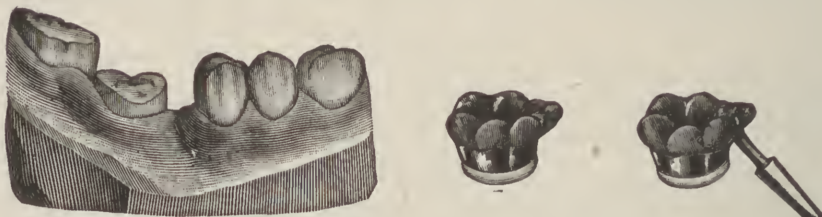
its integrity will be destroyed, and molding to definite, accurate outlines will be impossible.

When the imprint of the opposing teeth has been obtained satisfactorily, the band and wax cusps should be removed carefully from the supporting tooth. The interior of the band should be filled with casting investment compound, exercising care to exclude all contained air. Any contained air would destroy accuracy of adaptation. Immediate filling sustains the relationship of the wax and band, and facilitates carving. (Fig. 122 A.)



A B

Fig. 122.



A B C

Fig. 123.

Carving. When the investment compound has crystallized, the surplus wax should be trimmed down until even and flush with the band. The wax cusps then should be formed by carving, in which a reproduction of typical inclined planes, sulci, marginal ridges and grooves should be secured. (Fig. 122 B.)

Additional Contouring. Where the premature loss of an adjacent natural tooth precludes the restoration of contact by contouring the band (Fig. 123 A), the occlusal surface restoration may be made with the wax. (Fig. 123 B.)

Additional reinforcement, or additional contouring of the band, also may be made with wax at this time.

Investing and Casting. When all requirements have been observed, the sprue-former should be attached securely, usually at a point where the wax is thickest (Fig. 123 C), and the crown then invested and cast. Just previous to investing, it is well to submerge the crown in water

until the investment compound previously placed in the band is saturated. This precaution insures a close attachment of the freshly-made mix to be used in the final investment.

In order that the completed crown may be of uniform color, it is essential that a grade and color of gold similar to that of which the band is made, be used in casting the cusps.

The same grade of gold may be used without danger of melting the band, because the band is protected by the investment. The addition of a small proportion of solder to the gold to be cast, however, will reduce

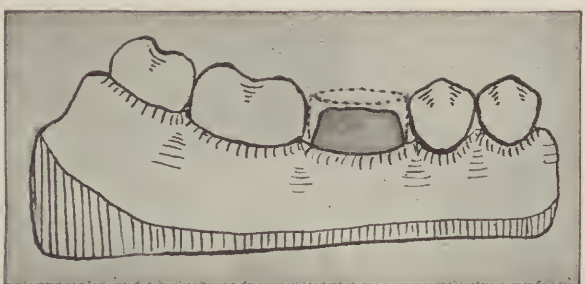


FIG. 124.

the fusibility and increase the fluidity, thereby insuring a better union with the band. Scrap gold may be used, provided it is of similar color, and provided also that it is melted and refined previously.

When the casting has been made, the crown should be cleaned in the acid bath. When all traces of investment compound and of acid have been removed, physical union may be insured by fusing a small bit of 22 karat or of 20 karat solder into the joint. The crown then should be finished and polished.

Variations.

While more, or less, accurate results are obtained from the simple technic just described, several variations of technic, insuring even greater accuracy, may be followed.

Accurate Interior Adaptation. The most accurate method of fitting the interior of the crown to the supporting tooth, or root, consists in taking an impression and making an amalgam cast of the tooth, or root, previous to making the band. A coping of thin, pure gold, about 36 gage, is then adapted closely to the amalgam cast, and trimmed to follow the gingival curvature uniformly around the entire circumference without

passing beneath the gingiva. When the coping has been made, the band is made and fitted as usual, and in accordance with all requirements.

The pure gold coping then is placed in position upon the supporting tooth, the band placed over it, and casting wax then forced firmly into the interior of the band and over the coping, and the requirements of occlusion observed. The same technic of investment and casting is then followed.

Irrespective of the length or shape of the supporting tooth or root, absolute accuracy in the interior adaptation of the crown is insured, and

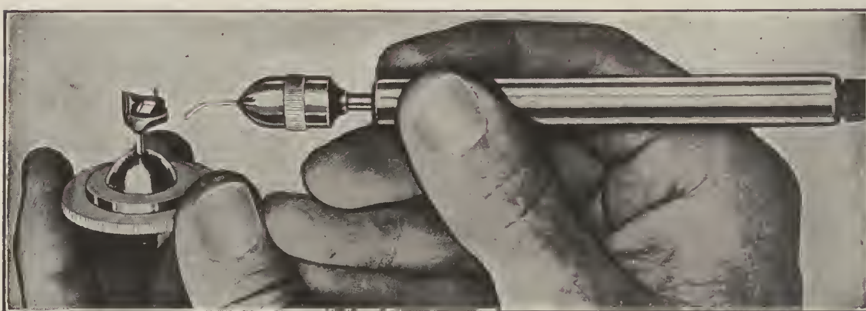


Fig. 125.

the highest possibilities of crown construction in which a peripheral band is used may be obtained from this technic, which is used extensively by Dr. W. D. N. Moore. (Fig. 124.)

Short Roots. In the construction of gold crowns for short roots, where the occlusal surface of the crown would be very thick and unnecessarily heavy, if constructed by either of the preceding methods, one or the other of two different procedures should be observed.

First: The root should be restored previously or built up to a more favorable height with amalgam. In very short roots this is the better procedure always. And the restoration should be made to a point approximating the length of the band when fitted and contoured. The restoration then should be finished and polished and the band made and the crown constructed as indicated.

Second: Where the root is not short enough to require restoration with amalgam, and yet where the cusps would be unnecessarily thick and heavy, the thickness of the wax may be reduced by the use of a "suction carver" designed for this and similar purposes. (Fig. 125.)

In the use of this instrument all unnecessary thickness of wax should be reduced from the interior of the crown just after the wax has been

molded to the requirements of occlusion. It should be reduced in such manner, however, as will leave a shoulder of wax remaining around the entire circumference of the interior of the band. The formation of this shoulder, when reproduced in the casting, will cause the finished crown to rest firmly upon the end of the supporting root when mounted. (Fig. 126.)

Any type of gold crown always should rest firmly upon the end of its supporting root. Crowns so constructed assume their proper position

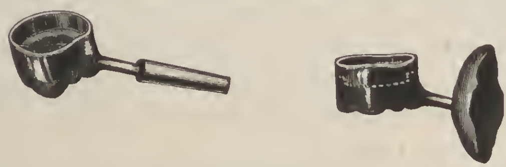
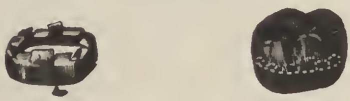


Fig. 126.



A B

Fig. 127.

on the supporting root much as an inlay goes to its place in a cavity. It is impossible to force them too far within the gingival border; therefore, less discomfort is occasioned, less irritation of the investing tissues is produced and less cement is required in mounting. And all of these features are desirable and advantageous.

Another variation of technic consists in making a narrow band and utilizing it for the purpose of obtaining gingival adaptation only, and then forming the crown entirely in wax. In this procedure a narrow band, made of 30 gage or of 32 gage gold or platinum, is fitted to conform to the requirements of gingival adaptation. Casting wax of proportions adequate to the size of the crown is then made plastic and modeled over the supporting root with band in position. When molded to contact with the band, and to meet all of the other requirements, band and wax are removed, their relationship sustained by filling with investment compound, then carved, invested and cast.

In this technic the band is used as a means of obtaining and insuring a degree of accuracy in the adaptation of the gingival edge of the crown, which would not be possible by the use of wax alone, and good results may be obtained.

Still another variation of technic, suggested by Dr. C. E. Meerhoff, consists in making the band somewhat wider than the length of the supporting tooth crown and then slitting the surplus occlusal end of the band

and overlapping the flaps thus formed upon the end of the root. (Fig. 127 A.) Wax then is molded and carved to meet the requirements and the casting made. (Fig. 127 B.) A good adaptation to the supporting root is insured by this method.

Indirect Method.

The indirect method involves the taking of the bite and impression and the making of casts. This method is indicated whenever it is desirable to transfer the technical procedure from the patient to the laboratory, and whenever accuracy may be obtained with greater facility by the use of casts. If an accurate bite and impression and an accurate cast may be secured, the indirect method may be used successfully in any of the preceding technical procedures.

When the band has been fitted, the bite should be taken in base-plate wax and the impression then taken in plaster. The band usually will be removed with the impression. If it is not removed it should be detached from its supporting root and placed carefully and accurately in place in the impression.

After varnishing the impression and before pouring the cast, the interior of the band should be painted with melted wax. This precaution will insure its subsequent detachment from and its accurate replacement upon the cast. The cast then should be poured. A good grade of hard plaster should be used. When the cast has been separated from the impression, the bite should be adjusted accurately and both mounted upon the articulator. A very hard plaster, or compound, should be used in mounting.

When the articulator has been separated and the wax bite removed, all unnecessary surplus should be trimmed away. The band then should be warmed and detached carefully, cleaned in the acid bath and replaced accurately in position on the cast.

Casting wax now may be made plastic, molded and carved as desired, and the crown invested and cast as indicated in the direct method.

Where a peripheral telescoping band is used, the application of the indirect method is seldom productive of any very great advantages. Indeed, one of the features of the casting process lies in the fact that much of the technical detail formerly transferred to casts, necessarily, now may be accomplished in the mouth directly.

Shoulder Crowns.

The gold telescope crown, however, is not limited to the use of the peripheral band. Where a peripheral band is used, the adaptation of

the gingival edge is made by overlapping the periphery of the root, thus making what is known as a "lapped" joint. A lapped joint may, or may not, preserve a close continuity between crown and root, and may, or may not, become a source of irritation. Both depend upon the closeness and smoothness of the adaptation at the immediate line of junction between crown and root.

Wherever a lapped joint may be made in such manner as to restore and preserve a close, smooth continuity between crown and root, without impingement upon the investing tissues, it will not be irritating to these tissues. But, unless the adaptation of a lapped joint does conform to these requirements, it will necessarily be a source of irritation. And, if it is a source of irritation, it will be a menace to health and a positive injury to these tissues.

The devastating influence of irritation which is invited by faulty adaptation of a lapped joint may be diminished greatly, or may be overcome entirely by the formation of a shoulder at the gingival line, and by the close adaptation of the gingival edge of the crown to this shoulder. By this means a "butted" joint between crown and root is formed, and a well-adapted and well-finished "butted' jointed unquestionably is the ideal procedure for conserving the normal conditions.

Indications. The demands of prophylaxis require that every means of eliminating, reducing or minimizing any and all forms of mechanical irritation of the investing and environmental tissues must be observed.

Therefore, if a peripheral band means irritation, and, if irritation is to be avoided by the formation of a shoulder at the gingiva and a shoulder crown restoration—then, a shoulder crown is indicated, wherever its successful construction may be insured. It is certain that the application of a shoulder crown which fits, conserves and reproduces normal conditions better and more closely than any other. And it is certain, also, that it is difficult to improve upon normal conditions.

Full Shoulder Crowns.

For these very important reasons, full shoulder crowns must be regarded as the ideal means of crown restoration, whenever and wherever the remaining natural crown may be prepared properly, and whenever and wherever accuracy of adaptation may be insured.

Because of the difficulty of conforming accurately, or adapting a plastic substance like wax to the entire periphery of a tooth or root, and to all other requirements, in the mouth, full shoulder crowns may be successfully constructed only by means of the indirect method.

Indirect Method. The technical procedure involved in the construction of full shoulder crowns in gold is identically the same as that used in the construction of full shoulder crowns in porcelain.

Unit Impression. The first essential requirement is a good, accurate impression of the remaining natural crown, as prepared, and including the shoulder as a single unit.

This impression is obtained, first, by carefully trimming and fitting an impression band or cup, which should always be done before the shoulder

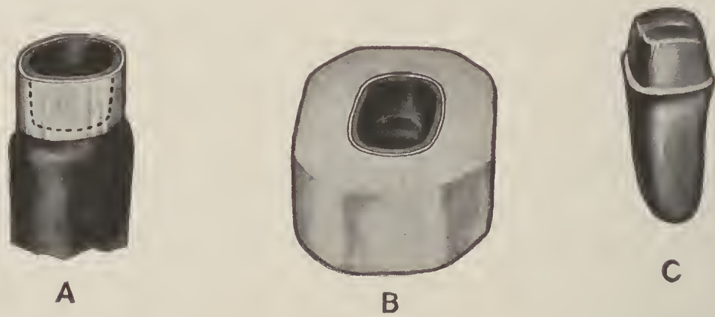


FIG. 128.

is formed, as this procedure avoids discomfort. Seamless impression bands, made of thin copper and aluminum, and in various sizes, are obtainable for this purpose. When a band of suitable size has been selected, or has been made for the case, it should be fitted to slip just freely over the remaining natural crown, including its shoulder, then trimmed to follow the gingival curvature closely.

When the impression band has been fitted, it should be filled, with a slight surplus, with impression compound made plastic in hot water, or over the flame. A special, hard impression compound, made in stick form, is prepared for this purpose. Band and plastic compound then should be forced firmly over the remaining natural crown and pressed rootwise until an imprint of the shoulder around the entire circumference is obtained. The impression should be held firmly in place until chilled with a spray of cold water, then removed carefully. Accuracy, definiteness and exactness in details must obtain in the unit impression.

Amalgam Cast. When a satisfactory impression has been thus obtained (Fig. 128 A), it should be imbedded in plaster in such manner as to form a matrix which will in turn form a base, or root extension, to the

amalgam cast. (Fig. 128 B.) A good grade of quick-setting amalgam should be mixed thoroughly and packed carefully into the impression, and the surrounding plaster matrix.

The amalgam cast of the prepared natural crown is useful only as a means of obtaining accuracy in the adaptation of the crown to the root itself. (Fig. 128 C.)

The requirements of occlusion, and of restoration of alinement and contact demand a cast which includes several adjacent teeth, together

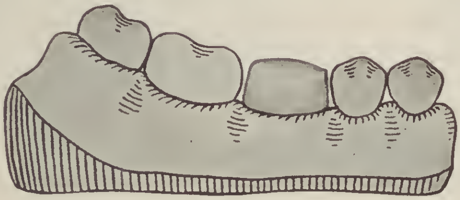


Fig. 129.

Fig. 130.

with the amalgam cast in its proper relationship, both to the adjacent and to the opposing teeth.

Several different lines of technical procedure may be followed in obtaining the maximum of requirements in this connection, but uniformly accurate and reliable casts should be obtained in the following manner:

After securing the impression of the remaining tooth crown as a single unit, in the manner indicated, a coping of base-plate gutta-percha, or of temporary stopping, should be molded over the remaining natural tooth crown to fill the space and to conform to the general outlines of the tooth to be restored. This coping, however, should not be brought into contact with the crowns of adjacent teeth, but the surfaces adjacent to the tooth being restored should be allowed to remain exposed freely. (Fig. 129.)

An impression to include several adjacent teeth, with this coping in place, now should be taken in plaster. The coping will be removed with the impression. (Fig. 130.) The bite then should be taken and the remaining details transferred to the laboratory.

When the amalgam has crystallized, the impression and cast should be placed in hot water and separated. The surplus base of the amalgam cast, which has been formed by the plaster matrix, now should be made somewhat conical in shape and finished with smooth disks. It is well,

FIG. 131.

FIG. 132.

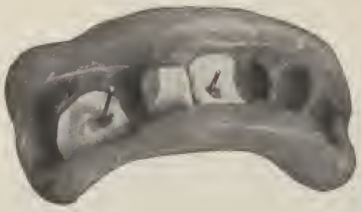


FIG. 133.

also, to designate the buccal surface by some form of marking. (Fig. 131.) This will avoid confusion or mishap in placing the cast into position in the plaster impression, or in the subsequent construction of the crown.

When the plaster impression has been varnished, the amalgam cast should be placed in position in the coping made of temporary stopping, or gutta-percha, and its proper position sustained with melted wax. (Fig. 132.) The certainty and the facility with which the cast may be placed in position in the coping of temporary stopping, or gutta-percha, gives immediate evidence of the advantage obtained by observing this detail. The cast, then, should be poured.

Absolute indestructibility of the crowns of the adjacent teeth on the cast may be obtained by filling their imprints in the impression with amalgam before pouring the cast. When this feature is observed the head end of a short, blunt pin should be imbedded in the amalgam as a means of sustaining it securely as a part of the resultant plaster cast. (Fig. 133.) And the amalgam should be allowed to crystallize before pouring the cast.

When the cast has been obtained (Fig. 134), the bite should be adjusted accurately to place, and both mounted on the articulator. When separated, the amalgam cast should be detached from the plaster cast in such manner as will admit of its ready and accurate replacement.

Fig. 134.

Fig. 135.

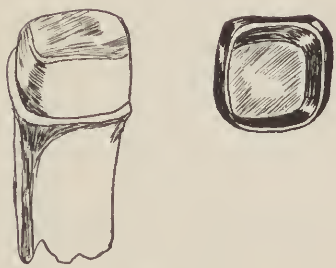


Fig. 136.

After thus detaching and replacing the amalgam cast, its exposed surfaces should be lubricated with thin oil and the desired crown restoration built with casting wax.

When the wax restoration has been formed and contoured to meet all requirements, a provision to allow for shrinkage of the casting must be made. Such a provision may be secured by cutting a slit entirely through the wax on both mesial and distal sides of the band, the slit extending from the cusps to the gingival edge. (Fig. 135.)

The sprue-former then should be attached securely at a favorable point and the restoration gently detached from the cast, invested and cast. After casting, removing all surplus and roughly finishing, the crown should be fitted to the amalgam cast. Driving to place by swaging may be necessary, but, if necessary, the amalgam cast will withstand it,

and accuracy of adaptation is insured. When the desired adaptation is obtained, the slits may be filled with high-grade solder and the crown finished and polished. (Fig. 136.)

Any effort to make the casting without thus, or in some similar manner, providing for shrinkage, will result only in failure.

Partial Shoulder Crowns.

Partial shoulder crown restorations are seldom used as a means of restoring the natural crown as a single unit. But they are used mainly and more or less extensively as a means of obtaining attachment for bridgework. Restorations of this type are known as "three-quarter" crowns and are applicable to the anterior as well as to the posterior teeth.

In the technical details of construction, either the direct or the indirect method may be used.

Indirect Method. In the use of the indirect method, the same technical details as apply to the construction of full shoulder crowns may be followed with good results. And the possibility of final swaging after casting is to be regarded always as an advantage of importance.

Direct Method. In the application of the direct method of constructing partial shoulder crowns, accurate results are to be obtained only in proportion as a careful and accurate technic is developed.

The most highly developed technic is suggested and used by Dr. E. T. Tinker. This consists in making and fitting the impression band to conform to all of the requirements previously indicated. When thus fitted, it is filled with casting wax heated in hot water until the proper plasticity obtains. Band and wax are carefully forced to place on the natural tooth crown until gingival adaptation is insured.

It is removed and all surplus wax extending or projecting beyond the band is trimmed away. Gingival adaptation of wax is perfected by trimming down to the desired point, or by the addition of a small bead of melted wax at some point, if necessary. Where melted wax is added, a fine spray of hot water is applied to the surface of the wax and it is forced to place again. This procedure is continued until the desired adaptation at the gingival line is obtained.

Band and wax then are held in place firmly, and the continuity of the band is destroyed by cutting it in two with a small, round bur. A small spray of cold water is directed upon the bur while cutting the band to prevent any overheating or distorting of the wax. The band is removed, and the gingival adaptation of the wax completed.

In posterior restorations, a spray of hot water is directed upon the

occlusal surface of the wax. By this means this surface of the wax is made sufficiently plastic to permit the firm closure of the opposing teeth. When this feature has been observed, all further requirements in the form of a reproduction of inclined planes, sulci, marginal ridges and grooves by carving are carried into effect. Then the sprue-former is attached securely and the pattern carefully removed, invested and cast. A special, hard, casting alloy always should be used for partial shoulder crowns.

After the casting has been made, it should be cleaned in the acid bath and then finished with stones and disks.

The final adaptation to the natural tooth crown may be greatly facilitated by carbonizing the casting first and then adjusting it to place on the supporting tooth crown. Carbonizing is accomplished by holding the casting in a *yellow* flame and allowing it to cool slowly. When carbonized and forced gently to position on the tooth, all points, or surfaces, which bind, or which prevent perfect seating of the gold are indicated by bright spots. These points should be relieved with small stones and the process of carbonizing, replacing and grinding continued until the desired adaptation is obtained.

The typical application of partial shoulder crowns both to anterior and posterior teeth is illustrated later in Fig. 267.

CHAPTER XI.

GOLD TELESCOPE CROWNS WITH PORCELAIN FACINGS.

Gold telescope crowns subscribe to all requirements of crown restoration, except in two particulars.

In their application, pulp conservation is possible. Conservation of remaining natural crown is possible. Accuracy of adaptation is possible. Restoration of function is possible. Strength of attachment to the supporting tooth, and a degree of indestructibility, which will insure permanency, are possible.

And, yet, however well gold crowns may subscribe to all these requirements, they do not meet the requirements of esthetics; nor do they subscribe to the highest possibilities of prophylaxis and of sanitation.

These two important requirements may be obtained by the use of porcelain, only. But porcelain is a friable substance, and crown restorations made entirely of porcelain are not applicable universally. They are not applicable universally as a single unit restoration because a degree of indestructibility not possessed by porcelain is demanded frequently. And they are not applicable where the restoration is to serve as an attachment for bridgework, because opportunity for attachment to them is not afforded.

All of the advantages of the full gold telescope crown, however, may be combined with an observation of the requirements of esthetics. These combined advantages are obtainable by the use of porcelain facings in combination with gold telescope crowns.

Indications. This type of crown construction is useful, and is indicated specially, in several different classes of cases.

First: In those cases where it is desirable to conserve the vitality of the pulp.

Second: Where it is desirable to conserve as much of the natural tooth crown as possible.

Third: Where the requirements of strength in the attachment of the crown to the supporting tooth make the telescoping principle of attachment preferable to the dowel principle, irrespective of whether the tooth has a vital pulp or is pulpless.

Fourth: Where the requirements of stress demand indestructibility.

Fifth: Where the use of gold as a means of affording opportunity for the attachment of bridgework is necessary.

Sixth: Where the requirements of esthetics preclude the display of gold, and demand the use of porcelain.

Application. The application of a type of construction which will afford all of these combined advantages is particularly useful in the restoration of the ten or twelve anterior teeth; or in the restoration of all teeth which are within the range of vision and where pulp devitalization and the use of dowel crowns is contraindicated.

Application to Posterior Teeth.

In the application of this type of construction to the restoration of bicuspids and first molars, two different methods of procedure may be followed:

First: The telescoping band may be made and fitted, a replaceable facing then adapted to the band, and the crown completed by casting the cusps directly to the band and to the backing for the facing.

Second: The gold telescope crown may be made with swaged cusps, and a thin, flat-back porcelain facing adapted subsequently, and soldered to the crown. Either method of procedure is productive of good results and each has a field of usefulness.

Advantages of Replaceable Facings.

The use of replaceable facings is indicated always in preference to the use of soldered facings, wherever possible. Replaceable porcelain facings are not weakened, primarily, by being subjected to the heat of soldering, nor by the influence of expansion and contraction because they are not invested with the parts to be united; hence, the finished crown, whenever a replaceable facing is used, is a stronger crown.

Replaceable facings, attached to the basic structure by means of cementation are stronger to begin with, and, being cushioned somewhat by the cement used in their attachment to the structure, they are less liable to fracture. Their replacement with ease and facility, in the event of fracture, and the additional advantages obtainable by grinding duplicates, at the time of construction, and preserving them for future use in case of accident, make the use of replaceable facings the preferable procedure in all cases.

Use of Replaceable Facings and Cast Cusps. The most ideal type of construction results from the use of replaceable facings, and from casting the cusps directly to band and backing.

In this procedure a wide telescoping band is made and fitted in accordance with all requirements. When adapted thus, the completion of construction can be accomplished best by the indirect method. This involves

A B

Fig. 137.

taking the bite with the band in position on its supporting tooth, and following this with a plaster impression. Before pouring the cast, the interior of the band in position in the impression, should be painted with melted wax. This precaution will permit of its subsequent detachment from the cast, and its accurate replacement thereon. The cast, then, should be made in plaster, the wax bite adjusted, and both mounted upon the articulator.

When separated, the band should be detached carefully from the cast and cleaned in the acid bath. A replaceable porcelain facing should be selected to meet the requirements of size, type and color. The buccal surface of the band should be cut away (Fig. 137 A), using small, pointed, curved shears, until accommodation obtains for the desired and required relationship between band and facing with its backing trimmed properly and in place. (Fig. 137 B.)

The reproduction of the root-end inside of the band should be varnished, now, to prevent the wax from adhering to it, and casting wax softened and molded over it—sufficient to fill the band. The exposed end of the porcelain facing, which is not covered by its backing, should next be lubricated, and for the same reason; facing and backing then should be forced to place in proper relationship with the band. This relationship should be sustained and the imprint of the opposing teeth in the wax obtained. Band, wax and facing then should be detached carefully from the cast, the surplus wax trimmed away and the necessary contouring and carving perfected. The porcelain facing now should be detached, the sprue-former attached securely, and the crown invested and cast. In

investing, it is extremely necessary that the interior of the band should be filled carefully with the investment compound, because the adaptation of the finished crown depends entirely upon an observation of this feature; and, also, care should be exercised in covering the exposed backing with investment compound, as a means of protecting it during the casting process.

A B C D

FIG. 138.

Backings for replaceable porcelain facings are made of gold alloy, and of base-metal or nickel alloys. Only those made of gold alloy should ever be used in casting. These may be used without danger of fusing, if casting into the mold when heated to a red heat is avoided.

After casting and finishing, the facing should be cemented to place, and when the cement has crystallized, the final polishing is given.

Use of Soldered Facings and Swaged Cusps.

In the procedure which involves the use of soldered facings and swaged cusps, the full crown should be made and completed, primarily. In its construction any method of forming the cusps by swaging may be used and either the direct or the indirect method is applicable, but a high grade of solder (22 karat) always must be used in soldering the band and in attaching the cusps. No reinforcement of the cusps should be made at the time of their attachment.

When the crown is completed thus and roughly finished, the buccal surface should be cut entirely as indicated in Fig. 138 A, using a thin, vulco-carborundum disk for the purpose.

A thin, flat-back facing of proper size, type and color now should be selected. The edges of the crown and of the facing then should be ground until the desired and required adaptation and relationship between crown and facing is obtained, with an allowance for the backing.

The facing, then, should be backed with pure gold, 36 gage, allowing a slight surplus to project upon all surfaces. (Fig. 138 B.) No effort to sustain the backing in its relationship to the crown should be

made at this time, but it should be burnished to close adaptation. Facing and backing then should be placed in position in the crown (Fig. 138 C), and the proper relationship between backing and crown designated by marking the backing, using a fine, pointed instrument. The facing should be removed, the backing placed in proper position and then soldered to the crown.

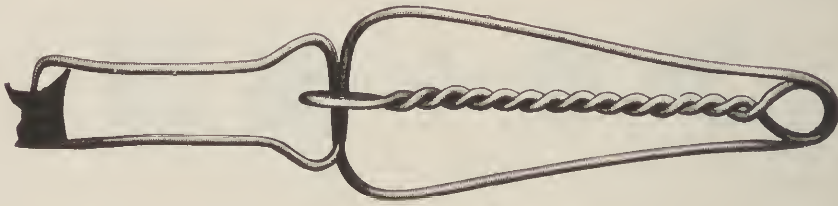


Fig. 139.

The soldering should be done from the outer surface of the crown and no investment is necessary. The proper relationship may be maintained while soldering by the use of soldering tweezers as indicated in Fig. 139. The ordinary, straight-pointed automatic or spring soldering tweezers may be adapted to this purpose by simply bending one end at a right angle.

The soldering should be done in a manner which will insure a flush joint between crown and backing when finished, and 20 karat solder should be used. The desired and required reinforcement of the cusps may be made after the backing has been soldered and as low as 18 karat solder may be used for this purpose.

When the soldering has been completed, the facing should be placed in its position in the crown (Fig. 138 D) and its relationship sustained and secured by bending the projecting ends of the pins down close to the backing, from the inside of the crown. If the porcelain is well protected by the gold at the occlusal angle, this simple retention, if further fortified by cementing the facing to the backing before bending the pins, may meet all requirements. Facings used in this manner are replaceable easily in the event of fracture.

But where the protection afforded by the gold is doubtful, or where greater strength in the attachment of the facing to the crown than is offered by the thinness of the pure gold backing is demanded, the pins may be soldered to the backing.

In soldering the pins to the backing, either of two methods of procedure may be followed:

First: Crown and facing may be invested with a thin covering of soldering investment compound, heated to a high heat over the flame, primarily, and then soldered with 18 karat solder, using a small, pointed flame from the blowpipe. In this procedure just enough soldering investment compound to protect the porcelain and the solder used pre-

Fig. 140.

viously, and to sustain the relationship, should be used. And the flame from the blowpipe must be small enough to penetrate the inside of the crown, and to reach the pins and solder. Such a procedure may be accomplished with ease, if the invested crown is heated previously to a red heat before attempting to solder.

Second: A simpler method of investment consists of wrapping the crown and facing in asbestos paper and holding directly in the flame. (Fig. 140.) This method may be used successfully if the asbestos paper is folded over and covers the occlusal end of the crown well, and if the crown and facing are heated slowly and carefully.

Silicate Cement Facings.

The silicate cements, instead of porcelain facings, may be used as a means of avoiding the display of gold in the restoration of bicuspids and first molars. In the use of these vitreous products for this purpose, the crown may be made by any of the methods described. Definite marginal angles and a retentive shape should be given to the buccal surface.

When the crown has been finished and polished, the desired color of silicate cement should be selected, mixed properly and carefully adapted to the surface outlines. When crystallized, it should be polished with fine disks, and then kept moist until the crown is mounted.

If the crown is to be used as an attachment for bridgework, the silicate facing should not be placed until the work is completed and finally polished. Artistic results are possible, but permanency of color and of form is doubtful.

Application to Anterior Teeth.

The combination of gold telescoping crown with porcelain facing is applicable also to the restoration of anterior teeth. In this application the type of construction embraces the features of an all-porcelain jacket crown, and differs only in the fact that the formation of a shoulder is unnecessary and the body of the restoration is made of gold.

When a crown is to serve as a single unit restoration, only, a full all-porcelain jacket crown would be the more ideal restoration in all cases.

But where pulp and tooth conservation are desirable, and where the restoration is to be used as an attachment for bridgework, thus demanding the use of gold for the purpose, or, in the absence of adequate, skilful technic, or of proper facilities for doing porcelain work, this type of construction often may be found useful.

In the construction and application of this type of crown restoration, the formation of a gingival shoulder is unnecessary for the reason that gold, instead of porcelain, is used in obtaining adaptation to the root. Gold, when finished down to a thin, attenuated edge, is not friable, hence a thin, overlapping, or telescoping joint may obtain in the use of gold, which would not be practicable in the use of porcelain alone.

Since the strength of the crown, even though it is made with gold in combination with a porcelain facing, must obtain at the expense of the supporting natural crown, it is necessary that a preparation of the remaining natural crown which will be favorable to the possibilities of strength in the restoration, must be made.

This means that the supporting natural crown must be sacrificed to an extent which will insure adequate inherent strength in the restoration, and to an extent often exceeding the requirements for a full porcelain jacket crown restoration as a single unit. The increased requirements in this connection are illustrated in Fig. 141 A.

Construction. The type of construction which is productive of the

best results in the application of gold telescope crowns in combination with porcelain facings, for the anterior teeth, is obtainable first, by taking a single unit impression of the remaining natural crown in hard impression compound and making an amalgam cast.

Coping. When the cast has been obtained, a coping of pure gold, 36 gage, should be adapted to it. This should be done previous to any of the following details of technic. A measurement of the circumference of

FIG. 141.

the tooth then should be obtained and a narrow band made, using 22 karat gold plate about 30 gage in thickness. The band should be trimmed to follow the gingival curvature, and, when so trimmed, should be adapted to the tooth.

When this adaptation has been completed, the thin, pure gold coping, which has been made previously, should be placed in position on the tooth, and the narrow band then forced over it and into position. The relation between coping and band should be sustained with wax, or temporary stopping, and the two removed. The interior of the band and coping should be filled with just enough soldering investment compound to sustain their relationship while soldering.

When the investment compound has crystallized, the wax, or temporary stopping, should be warmed and removed carefully. The band and coping, then, should be united with 22 karat solder. In uniting them, the lingual surface may be reinforced with solder sufficiently to insure a retention of form and shape. But the labial surface should remain thin in order to accommodate the subsequent adjustment of the facing.

The coping, now, should be fitted finally to the supporting tooth and all requirements of adaptation perfected. The band around the labial gingiva may be allowed to remain as wide, or as narrow, as the requirements may seem to indicate; or it may be cut away entirely at this point.

The remaining details of construction may be secured best by the indirect method. When the final requirements of adaptation of the coping have been completed, it should be placed in position on the tooth, and the bite and impression taken.

A bite may, or may not, be necessary in anterior crown restorations, but it is always safest to have this guide and to be fortified with the assurance of a correct relationship of the opposing teeth.

The impression should be taken with plaster. When the impression has been varnished, and just previous to pouring the cast, the interior of the coping should be painted with melted wax. This precaution permits of its subsequent detachment from the cast without danger of distorting its shape. The cast now should be poured with plaster.

When the casts have been obtained, the coping should be warmed over a flame and detached carefully; then cleaned in the acid bath and replaced.

The porcelain facing then should be selected. The replaceable type should be used, if possible, but the required thinness may demand the use of a long-pin facing. Where a replaceable facing may be used, it should be placed in position on its backing and the two then ground to the desired adaptation. When this has been secured the relationship should be sustained with wax, the facing removed, and the crown detached from the cast.

The completion of the crown may be accomplished either by casting or soldering as the requirements may indicate. Where some opportunity for contouring the lingual surface, and where some little thickness of wax presents, casting produces the best results. But if extreme thinness is demanded, soldering may be preferable, or may be necessary.

Replaceable Facings. In the use of replaceable facings, where the crown is to be completed by soldering, the backing should be extended to cover the gingival end of the porcelain, as a means of obtaining a more sanitary and more finished result.

Such extensions are secured readily and easily by tacking a small piece of platinum foil, 1-1000 in thickness (or pure gold 36 gage) to the backing with a small bit of solder. After being attached, thus, to the backing, this extension then may be burnished closely to the neck of the facing and all surplus trimmed away until a continuous backing presents.

Flat-back Facings. The ordinary long-pin facings may be used successfully also. Those of the long, thin-neck variety are adapted especially for this purpose. (Fig. 141 B.) In their use the selection and the subsequent adaptation should be made with care. When the desired adaptation has been obtained (Fig. 141 C), the facing should be backed with pure gold, 36 gage. (Fig. 141 D.) Then it may be attached to the coping by means of casting or of soldering.

Casting. When the crown is to be completed by casting, the facing and backing should be placed in their proper relation to the coping and the desired contour made with casting wax. This completed, the facing should be detached from its backing and small graphite pins then inserted into and to the full depths of the holes made and left in the wax by the pins. Pocket pencil leads answer this purpose nicely and the use of these graphite pins reserves accommodation for the pins of the facing after the casting is made. Afterward, they may be removed from the casting by boiling in dilute hydrochloric or sulphuric acid. When this procedure is followed it is well, also, to lubricate the projecting ends of the pins as a means of facilitating their subsequent detachment from the wax.

When the crown has been cast, and the graphite pins have been removed from the holes, the facing should be adjusted to position and finally cemented. Threading the pins with a small tap, which is made for this purpose, affords increased strength in the attachment of the facing with cement.

Soldering. Where the crown is to be completed by soldering, the same procedure may be followed to good advantage in all cases where the pins may be allowed to remain their full length. All of the advantages to be obtained by cementing the facing present. But in cases where the pins must be shortened in order to effect the desired adaptation of the facing to the coping, soldering may be indicated.

Where the attachment of the facing by soldering is indicated, the pins should be bent over upon the backing, and the crown then invested, heated carefully and, finally, soldered.

CHAPTER XII.

DOWEL CROWNS.

The telescoping method of attachment permits pulp conservation, and of the conservation of the remaining natural tooth crown. The dowel method of attachment is applicable to pulpless teeth only, and requires the removal of the remaining natural crown to the gingival line.

Wherever the pulp must be devitalized, or where it has been devitalized; wherever the pulp-canal must be filled, or where it has been filled; wherever the remaining natural tooth crown must be sacrificed to the gingival line, or where it may have been thus sacrificed previously; and where the esthetic requirements demand a porcelain restoration of the lost natural crown, some type of dowel crown is indicated as a means of insuring stability and permanency in the attachment of the restoration to the supporting root.

This type of crown restoration was designated formerly as a "pivot" tooth, and, later, as a "Richmond" crown. It is applicable to the restoration of the crowns of all teeth within the range of vision, and much versatility in the methods and technical details of construction has been displayed.

Dowel. The use of a dowel is the mechanical means of obtaining resistance to stress and of insuring strength and stability in the attachment of the crown to its supporting root. Accommodation for the dowel is made by enlarging the pulp canals.

Coping. A coping may or may not be used. Accuracy of adaptation of the crown restoration both to the periphery and to the basal end of the supporting root, however, is increased and insured by the use of a coping. And in proportion as accuracy of adaptation of the basal end of the crown to its supporting root is obtained, protection of the root against the influence of caries and against the possibilities of fracture also will be secured. And permanency in the restoration will be increased correspondingly.

It is in the direction of making and adapting the coping that the greatest versatility has been exhibited. Full bands encompassing the entire

circumference of the root are used. Partial bands adapted to all surfaces, except the labial or buccal, are used. And copings adapted to the basal end only, and without any band whatever, are used.

These variations all have a place of usefulness, and the requirements of root protection and of dowel crown construction are so varying that no one method of procedure nor any one type of construction is applicable universally to all cases. Success, therefore, will depend upon the exercise of judgment in the choice of that method which seems best adapted to the requirements of the individual case.

Requirements. The requirements incident to the application and construction of dowel crowns may be considered from three viewpoints: physiological, mechanical and esthetic.

Physiological.—As pulp devitalization, pulp removal and root-canal filling are necessary, and since the health of the supporting root and of its investing tissues, and, hence, the success and permanency of the crown restoration, are to depend entirely upon the successful execution of these procedures, it is evident that the requirements in this connection must be met properly and to the fullest extent.

Radiographic evidence that no eradicable infection presents, that health obtains, and that the root canals are filled well, always should precede all mechanical efforts in the direction of restoration.

In addition to the requirements pertaining to the conservation and maintenance of health, the restoration of function must be considered because health will not be maintained unless normal functional activity in all directions is restored.

A restoration of normal functional activity demands that the physiological requirements of alinement, approximal contact and occlusion be satisfied always—and carefully.

Mechanical. Following an observation of the physiological requirements, maintenance of the health of the investing tissues will depend largely upon the absence of gingival irritation, and the absence of the latter will depend entirely upon accuracy of adaptation in the relationship existing between the supporting root and the crown restoration.

Hence, in the adaptation of the crown to the supporting root, with or without a coping, the adaptation must be made in such manner and with such accuracy as to preclude, or, at least, minimize the possibilities of mechanical irritation. This applies in all cases, whether a coping is used or not, or whether a full band, a partial band, or no band at all is involved.

An observation of this requirement means: First: the supporting root

must be prepared properly to receive whatever type of coping, or of crown, is indicated and is to be used; and, second: an accurate adaptation of the crown, both to the periphery and the basal end of the root, must exist always. The success of the restoration, from a mechanical viewpoint, depends entirely on a strict adherence to these procedures.

Esthetics. An observation of the requirements of esthetics is made possible by the use of porcelain. An ambition to develop an eye for

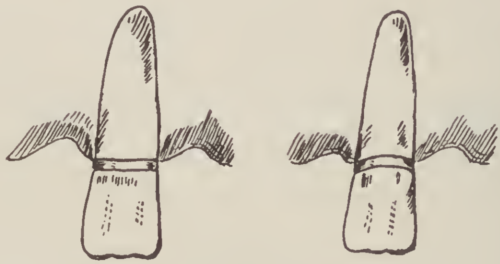


FIG. 142.

color and for form, an appreciation and a recognition of Nature's great law of harmony and an effort to simulate existing environmental conditions, are all essential to the achievement of the highest possibilities in the use of porcelain, and in the construction of dowel crowns.

Color. In the selection of porcelain teeth or facings which are to be used in the restoration of the crowns of all teeth within the range of vision, it is essential to exercise the greatest care in matching the color of the natural crowns of the adjacent teeth.

The selection must be made with a view to insuring a finished restoration that will match the crowns of the adjacent teeth so closely in color that it will not be conspicuous. If the color cannot be matched perfectly, or even closely, a shade darker, rather than a shade lighter, always should be used.

Type. To obtain an expression of harmony in the restoration, the selection of the porcelain tooth or facing to be used should be made always with a view to simulating the form or type of the crowns of the adjacent natural teeth. In this connection it is especially necessary that the type of tooth selected should simulate closely the type of the crown of the corresponding tooth on the opposite side of the arch. Thus, a central incisor should resemble its mate closely in type. A lateral incisor should correspond in type with its mate, the opposite lateral incisor, and a cuspid likewise, should correspond with the cuspid present.

Harmony. Color and type constitute two expressions of harmony. In restorations involving the six anterior teeth, however, further expressions of harmony are to be obtained by simulating closely the incisal edge, incisal angles, abrasions, erosions and discolorations of the adjacent teeth, or of the corresponding natural tooth crown.

Display of Gold. Any unnecessary display of gold is always objectionable. But in cases where the natural crowns of the adjacent teeth are filled freely with gold, and where the restoration would be the only tooth not so defaced, and therefore conspicuous because of its perfection, the insertion of small gold fillings, in the restoration, may add a further and desirable expression of harmony by simulating more closely the environmental conditions.

The display of gold at the gingival line, however, is objectionable and should be avoided always. A display of gold at this point is a common fault in the construction of dowel crowns with full peripheral bands. This fault is to be overcome by making the band narrower and by observing the proper gingival curvature of the band and facing, in the construction of the restoration. (Fig. 142.)

Methods of Construction.

In the construction of dowel crowns several methods of procedure are followed. These methods involve, primarily, the construction of a supporting coping, of which the dowel becomes an integral part.

Construction of Coping. In the construction of the coping, the variations of the construction are the use of a full peripheral band, a partial band only, and of no band at all. And, both the direct and the indirect methods of construction are applicable to all types.

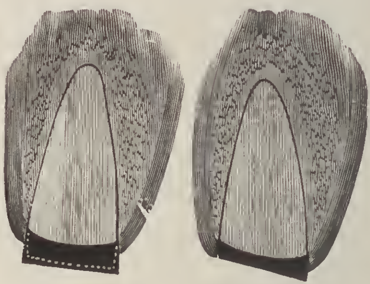
Copings with Full Peripheral Bands.

The construction of copings involving a full peripheral band may be made successfully either by the direct or the indirect method. This type of construction is indicated most generally in cases where the crown is to serve as an attachment for bridgework.

Direct Method. In the application of the direct method of construction, a wire measurement of the circumference of the root at the gingival line is taken with measurement wire. A narrow band is made, using 22 karat gold plate, 28 or 29 gage, cut to the exact length (Fig. 143) and soldered with 22 karat solder.

The band is purposely made much wider than necessary, in order that it may be trimmed to follow the gingival curvature evenly and to facilitate fitting. It is then conformed to the general outline of the root, trimmed to accommodate the gingival curvature, and gently forced to place upon the root until the edge passes just within the free gingival margin

Fig. 143.



A B

Fig. 144.

uniformly. It is then removed and the surplus edge cut away until the desired width obtains.

Full peripheral bands for dowel crowns are used only for the purpose of protecting the supporting root more adequately against the possibility of fracture, and of obtaining a maximum of strength in the attachment of the restoration, and a maximum of protection to the cement to be used in mounting.

The band around the labial or buccal surface of the root should be only wide enough to afford these features, and to admit of placing the gingival edge of the porcelain tooth, or facing in close proximity to the gingival tissues. It may and should be wider upon the mesial, distal and lingual surfaces. Its width, however, must be governed by the shape given to the basal end of the root (Fig. 144 A), and the edge must be trimmed to approximate this surface of the root evenly at all points. (Fig. 144 B.)

When thus trimmed, it may be removed, using a small, pointed instrument for the purpose. A floor now should be soldered to this edge of the band. While the same thickness and karat of gold used for the band may be used for the floor, it is desirable to use a thinner gage in order to admit of placing the porcelain tooth, or facing, in closer relationship with the gingival tissues. Hence, 32 gage, 22 karat gold, or 36 gage platinum should be used. Platinum of thinner gage than gold

may be used because of its higher fusibility. No special degree of strength is needed in the metal used for the floor because it is to be reinforced adequately later.

In soldering the floor to the band, a liberal surplus of the floor metal will facilitate the procedure, and only sufficient solder of 22 karat or 20

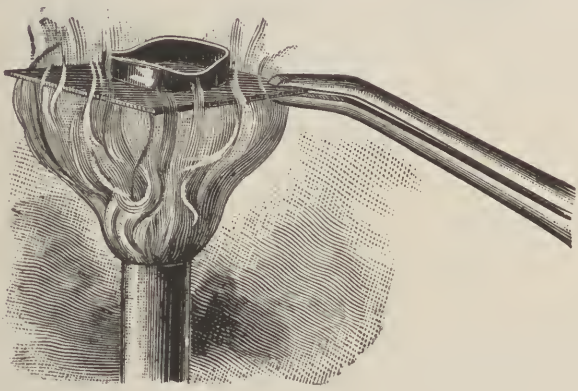


Fig. 145.

Fig. 146.

karat to unite floor and band should be used. The soldering may be accomplished by holding the parts directly in the flame as indicated in Fig. 145.

When band and floor have been united thus, the surplus should be trimmed away and the coping then finished to the point of polishing.

Reinforced Bands. Greater strength and better formation of the gingival outline of the completed restoration will be obtained by reinforcing the mesial, distal and lingual surfaces of the band. This reinforcement may be accomplished easily by allowing a slight surplus of the floor to extend from the band upon these surfaces, painting the interior of the coping with whiting, and then forming the desired reinforcement with 22 karat solder. (Fig. 146.)

The use of whiting painted on the inside of the coping prevents refusing the solder previously used in uniting band and floor. It also prevents the solder from flowing to the inside of the coping.

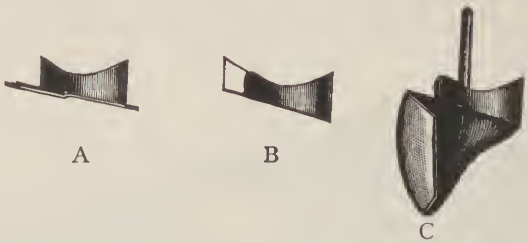


Fig. 147.

Coping with Partial Bands.

In many cases a full peripheral band is both unnecessary and objectionable. It is unnecessary because all of the advantages of a full band may be obtained by the use of a partial band. And it is objectionable because the normal condition of the labial or buccal gingiva is disturbed, recession of these tissues is invited, and some display of gold is unavoidable.

In the application of dowel crowns to the ten anterior teeth, therefore, if the use of a band is indicated at all, a partial band, adapted to all surfaces except the labial or buccal meets all requirements, eliminates some objectionable features, and affords the most favorable type of construction.

Copings which involve the application of a partial band only may be constructed either by the direct or the indirect method.

Direct Method. In the application of the direct method, the best results are obtained by making and fitting a full band, primarily, and attaching the floor to it in exactly the same manner indicated previously, except that the floor is not soldered to the band along the labial or buccal edge.

To prevent the floor from becoming attached to the band at this point, the edge of the band may be painted with whiting, or other suitable antiflux, or a piece of very thin mica may be inserted between band and floor at the desired point. (Fig. 147 A.)

The floor then should be soldered to the remaining edge of the band and the desired reinforcement made, after which the labial or buccal surface of the band may be cut away to the desired point. (Fig. 147 B.) This unsupported edge of the floor finally may be adapted directly to the

root, and a well-adapted coping having a partial band, only, obtains. (Fig. 147 C.)

Burnishing. Another and simpler method of constructing a coping having a partial band is by burnishing the coping to the desired form and outline directly upon the root. Burnishing, however, while a simple pro-

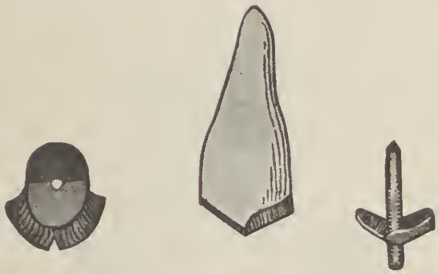


Fig. 148.

cedure when soft metals of thin gage are used, is not always productive of accuracy. It is always difficult and uncertain because of the attending discomfort.

Where a coping with a partial band is to be constructed by burnishing, a piece of thin platinum, or pure gold, about 36 gage, should be cut somewhat larger than the size of the root. Gold, being the softer metal, is adapted more readily by burnishing, and the best results, therefore, are obtained from its use. The piece should be annealed, placed in position upon the root, held in place firmly and burnished carefully to the basal end, using blunt instruments. When the outline of the end of the root is well defined in the surface of the gold, the surplus around the labial or buccal edge should be trimmed away entirely. Only enough surplus to form the partial band should be permitted to remain around the mesial, distal and lingual surfaces. This surplus then should be slit in the center of the lingual surface and at one or more other favorable points. It then may be replaced upon the root and the flaps formed by slitting, bent over upon and burnished closely to these surfaces of the root. When the desired accuracy of adaptation has been secured, the slits may be filled with 22 karat solder, and the coping completed. (Fig. 148.)

Coping without Band.

A coping having no peripheral band whatever, and yet well adapted both to the basal end and to the periphery of the root, is the least irritating and the most ideal construction.

Where the crown is to serve as a means of affording attachment for bridgework, the use of a partial band, and, in some instances, the use of a full band, is advantageous, and, perhaps, necessary. But, where the crown is to serve merely as a single unit restoration, the use of any form of band is unnecessary in a very large proportion of cases, provided that the coping is well adapted both to the basal end and to the periphery of its supporting root.

Direct Method. The adaptation of coping without a band may be obtained with some degree of accuracy by means of the direct method, or by burnishing directly upon the tooth. Platinum or pure gold of about 36

FIG. 149.

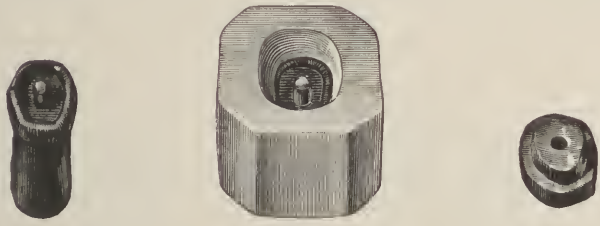
gage should be used. The same detail of procedure indicated for partial bands should be followed with the same relative advantages of platinum over pure gold. (Fig. 149.) More accurate results and less discomfort, however, are to be obtained, always, from the indirect method, and from swaging instead of burnishing.

Indirect Method. In the construction of copings by the indirect method, greater simplicity in the technical details of procedure and increased accuracy of adaptation both to the periphery and to the basal end of the root obtain. These features may be secured by taking a single unit impression of the root-end, making an amalgam cast, and swaging the coping in one single piece.

The additional time required in this method is compensated for by the increased accuracy of adaptation. And this advantage is combined with the further advantage of making a coping which may embrace and include a full band—any part of a band, or no band at all—as the requirements of the case or the preference as to type of construction may indicate.

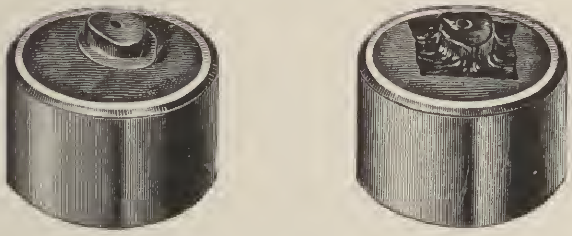
In the application of the indirect method, a free exposure of the root-end is absolutely necessary. If the root-end is not exposed freely, the gingival tissue should be packed away first, until a favorable exposure is obtained. This may be accomplished by mounting some type of temporary crown previously, or by packing temporary stopping tight over the root-end.

A unit impression band of a size which will pass just freely over the root-end, should be selected and trimmed to meet the gingival curvature evenly upon all surfaces. An impression of the root-end should be taken with impression compound. (Fig. 150 A.) The impression then should be invested in plaster in such manner as to form a matrix for the body of the amalgam cast. When the plaster has crystallized, the matrix should



A B C

FIG. 150.



A B

FIG. 151.

be trimmed until all surfaces of the imbedded impression are exposed freely. (Fig. 150 B.) The amalgam cast now should be made.

When the cast has been obtained (Fig. 150 C) it should be mounted in impression compound in a metal ring, such as constitutes a part of various swaging and moldine outfits. The ring of a casting flask will answer the purpose. (Fig. 151 A.)

Platinum or pure gold, 36 gage, should be conformed to the surface outlines of the amalgam cast by swaging or burnishing. (Fig. 151 B.) During the process of swaging or burnishing, the metal should be annealed often, and the surplus trimmed away gradually until the adaptation and the desired outlines are obtained.

The use of a thin gage of metal facilitates the adaptation, and while pure gold is adapted with more ease, the use of platinum is preferable because of its greater resistance and higher fusibility. The greater resistance of platinum insures the retention of its given form and shape, and its higher fusibility eliminates the possibility of subsequent fusing in the final assemblage of the crown. The use of platinum, therefore, will afford the best and most reliable results when the coping is constructed by the indirect method.

Dowels.

When the coping is completed by any of the preceding methods, it should be placed in position on its supporting root and the dowel fitted and subsequently soldered to it. A dowel embracing all requirements for the individual case then should be made.

In enlarging the pulp canal to receive and accommodate the dowel, it should be noted that the enlargement of the canal at is orifice in the basal end of the root is made at the expense of the lingual area, mainly, or, perhaps, entirely. An observation of this precaution carries the end of the dowel to a point where it will accommodate the proper and desired relationship of the porcelain tooth or facing to be used with the coping when it is attached to, and becomes an integral part of the restoration subsequently.

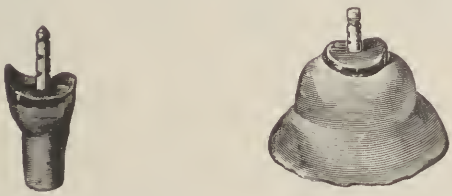
The importance of observing this precaution at this time must not be underestimated. And, in order to obtain the desired relationship between the coping, the dowel and the porcelain tooth or facing to be used, the porcelain tooth or facing should be selected previously. When the pulp canal is enlarged thus to receive and accommodate the dowel, the coping should be placed in position on the root and the floor perforated. The perforation should be made of such size as to fit the dowel closely, and should be placed at a point which will receive and sustain the dowel in its proper relationship.

If by any mishap the perforation should be made too large to afford contact with the dowel around its entire circumference, another and a smaller piece of gold or platinum may be perforated properly and burnished to a close adaptation to dowel and floor, thus restoring contact and facilitating soldering. This supplementary piece will become a part of the coping at the time of soldering the dowel.

When the desired relationship has been obtained, it should be sus-

tained temporarily (Fig. 152 A) and coping and dowel then removed carefully and invested and soldered. Adhesive wax, base-plate wax, or temporary stopping answer this purpose nicely, and either may be removed easily after investment. An investment compound which crystallizes should be used and a larger quantity than just sufficient to sustain the relationship while soldering (Fig. 152 B) is unnecessary.

Dowels in Multi-rooted Teeth. In the construction of copings for multi-rooted teeth, one dowel is all that will be required, provided it en-



A B

FIG. 152.

FIG. 153.

gages the canal to a sufficient depth, and provided that it is proportionate in diameter with the requirements of strength. Where these two features may not be observed without endangering the strength of the root unnecessarily, more than one dowel may be used. Where more than one dowel is used, they may be made shorter in length and smaller in diameter.

In upper first bicuspids, if one dowel will meet the requirements, it should be placed in the lingual canal in order that its surplus end may offer no obstruction to the placement of the porcelain tooth or facing in its desired relationship. If two dowels are necessary, care must be exercised not to weaken the root unnecessarily in the enlargement of the canals to receive the dowels. (Fig. 153.)

The same precautions and the same care must be observed with molar roots.

Application of Porcelain Teeth or Facings.

When the coping has been constructed and adapted by any of the preceding methods, the porcelain tooth or facing to be used should be selected. The selection of the tooth or facing is an important detail and should be made even before the completion of the coping in most cases, for the reason that some special technic is most applicable, usually, to the particular type of tooth or facing used.

The esthetic requirements of dowel crown construction may be met by the use of two different types, full porcelain crowns and simple facings.

Use of Full Porcelain Crowns.

Full porcelain crowns are applicable in the construction of dowel crowns in all cases where the requirements of occlusion will admit their use without extensive grinding. When a selection may be made which will not require extensive grinding, this type of porcelain tooth will possess strength adequate to the requirements in most cases. But where extensive grinding becomes necessary, the strength of the porcelain is diminished accordingly, and may be diminished to a degree which will contraindicate the use of an all-porcelain crown and demand the greater indestructibility obtainable by the use of a simple facing only.

Advantages. Where full porcelain crowns may be used, better form, better color and higher esthetic possibilities constitute the chief advantages. In the restoration of the crowns of the six anterior teeth, gold backings are avoided; hence, greater translucency, and, therefore, better color is assured. And, in the restoration of crowns of posterior teeth, the use of all-porcelain crowns insures better form and greater masticatory efficiency than may be obtained by the use of simple facings in combination with gold.

When these advantages are to be combined with the further advantage which is obtainable from cementing the porcelain to its supporting basic structure, and from making and retaining duplicates at the time of construction, the highest possibilities of dowel crown restorations are achieved.

Any of the all-porcelain crowns not having dowels as an integral part may be used. The Goslee tooth was designed especially to meet all of the requirements of dowel crown restorations *without grinding.* But any of the all-porcelain crowns without attached dowels may be used to advan-

tage, and successfully, by grinding the basal end to simulate the general form and outlines of the original Goslee tooth. (Fig. 154.)

Application. In the construction of dowel crowns in which this type of all-porcelain tooth is used, the adjustment of the tooth to the coping is accomplished best by making it directly upon the supporting tooth in the mouth, and by doing this before the dowel is soldered to the coping.

Fig. 154.

Direct Method. The tooth to be used should be selected when the coping has been made and adapted. Then it should be ground to meet all requirements of gingival curvature, contact, alinement and occlusion. When these requirements have been met, the coping should be placed in position on the root and perforated to receive the dowel. The dowel now should be adjusted to the root in such manner as to sustain the proper and desired relationship between coping and tooth. When this has been done, the adjustment of the dowel to the coping should be sustained with melted wax. Dowel and coping now should be detached from the root, invested, as indicated previously, and then soldered. (Fig. 155 A.) A small bit of solder only should be used because any unnecessary surplus

might interfere with the adjustment of the porcelain tooth to the coping after soldering.

Up to this point the coping fits the root but does not fit the tooth. Adaptation to the basal end of the porcelain tooth, together with adequate

A B

Fig. 155.

A B

Fig. 156.

reinforcement of the coping must then be secured. These may be accomplished by casting or by soldering.

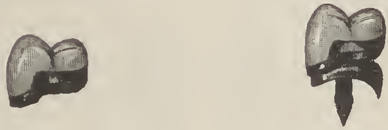
Casting.

The casting method offers the best and simplest means of completing the coping. When it is to be used, the final adjustment of the porcelain tooth to the coping should be made with casting wax, and the best results are obtained by making the adjustment directly in the mouth.

To accomplish this step of the procedure in the best and most simplest manner, a small bit of soft casting wax should be melted upon the surface of the coping first, and the coping placed in position on the root. The basal end of the porcelain tooth now should be lubricated with oil and the tooth forced to place in its relation to the coping. The soft wax admits of and sustains this relationship.

Tooth and coping now should be detached from the root carefully, and the space between them filled with melted casting wax until completely filled and until the desired contour is obtained. (Fig. 155 B.)

The use of a hard casting wax is advantageous for this purpose because retention of shape and form is necessary. When the desired shape and form obtain, the porcelain tooth should be detached carefully from the wax, then replaced, and the sprue-former attached securely where the wax is thickest. (Fig. 156 A.) The porcelain tooth now should be removed and the investment and casting made.



A B

Fig. 157.

A high grade gold alloy should be used in making the casting, and 22 karat is preferable. When the casting has been made (Fig. 156 B), the surplus should be cut away, the base cleaned in acid and then finished, and the porcelain tooth cemented to place. A physical union between pure gold coping and casting may result; but, if it does not result, a small bit of 22 karat or of 20 karat solder may be used.

Soldering.

When it is desirable to complete the construction of the coping by soldering, instead of by casting, a backing of pure gold (36 gage) must be adapted to the basal end of the porcelain crown previous to the final adjustment of the tooth to the coping.

The adaptation of the backing to the porcelain crown may be made by burnishing, and a slight surplus of the backing should be allowed to remain and to lap over upon the porcelain until after the soldering has been completed. (Fig. 157 A.)

When the porcelain crown has been backed with pure gold in this manner, the backing should be perforated immediately over the hole in the crown, and the relationship between the crown and its backing and the coping then obtained. (Fig. 157 B.) This relationship may be sustained with soft base-plate wax. Crown and coping now should be detached from the root, the space between coping and backing filled with melted wax, and the crown removed.

Coping and backing then should be invested, using enough investment only to sustain their relationship securely. When the investment has

crystallized, the wax should be removed with boiling water, the surfaces of metal fluxed, and the case placed over the flame and heated to a high temperature. The space between coping and backing then should be filled completely and to the desired contour with 22 karat or 20 karat solder. The base, thus completed, should be cleaned in acid, the porcelain crown cemented to place, and the crown finished and polished.

Fig. 158.

Indirect Method.

The indirect method is applicable to the construction of crowns of this type, but does not afford the same opportunities for alining and adjusting the crown and the dowel to the root with quite the same degree of accuracy and facility.

Where it may be desirable to use the indirect method, the adjustment of the dowel to the coping and to the crown must be made directly upon the root. When this adjustment has been secured, and when the dowel has been soldered to the coping, the indirect method may be followed successfully in the completion of the crown.

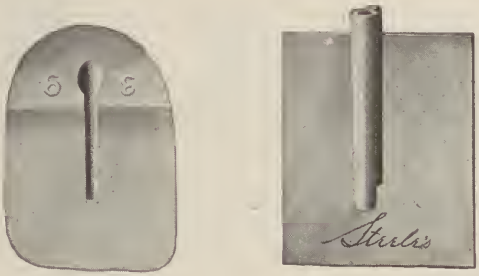
This procedure consists in taking the bite in wax and the impression in plaster, with the completed coping in position on the root. The coping, usually, will be removed with the impression, but its correct relationship must be insured. The exposed surfaces of coping and dowel then should be painted with melted wax as a means of insuring removal from and accurate replacement upon the cast. The impression should be varnished and the cast poured in plaster. When the cast has been obtained and mounted upon the articulator, the coping should be warmed, detached, cleaned in acid, and then replaced upon the cast.

The remaining details of construction may be carried out, as indicated, and the coping may be completed either by casting or soldering. (Fig. 158.)

Use of Porcelain Facings.

The use of porcelain facings, instead of all-porcelain crowns, in the construction of dowel crowns, produces results that do not subscribe to

the esthetic requirements to the same degree, but greater indestructibility may often be obtained: First, from constructing the body of the crown with gold; and, second, from protecting the thin porcelain facing in proper manner.



A B

FIG. 159.

Two types of porcelain facings are used. These are known as "removable and replaceable" facings, and "flat-back" facings.

Indications. The use of thin porcelain facings of some type is indicated in all cases where the occlusion and the requirements of stress demand greater indestructibility than is possessed by an all-porcelain crown.

Removable and Replaceable Facings.

Every advantage obtainable from the use of porcelain facings is secured in the best manner by the use of replaceable facings.

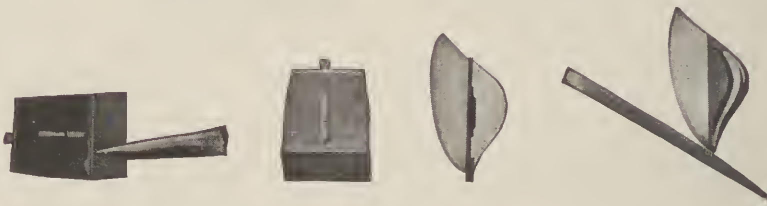
In the use of facings of this type, the porcelain is not subjected to the heat of soldering; its attachment to the supporting structure being cushioned by cement is less rigid, and, therefore, it is less likely to be fractured; duplicates may be made at the same time; every opportunity for replacement presents, and special backings are made for them.

The type known as Steele's Replaceable Facings are used generally. These are made in thin veneer facings for the six anterior teeth. (Fig. 159 A.) A different type of bicuspids and molars presents an occlusal surface of porcelain. But the posterior teeth are adapted better to the requirements of a pontic for bridgework, than they are to the construction of crown restorations.

Special backings made of gold alloy and also of a base metal alloy which will withstand high grade solders, or casting, are made for use with these facings. (Fig. 159 B.) The time required for making a backing, therefore, is saved. Backings made of gold alloy are preferable.

C D

Fig. 159.



E

Fig. 159.

Application. For the reason that the adjustment of the facing and its backing to the coping is made in the best manner when casts are used, the application of replaceable facings to the construction of dowel crowns is best secured by the use of the indirect method in all cases.

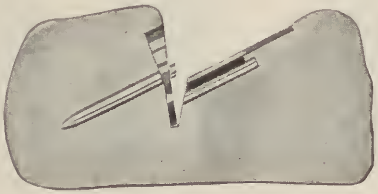
Indirect Method. In the application of the indirect method, the coping should be made and completed, and the dowel soldered to it. The bite and impression then should be taken with the coping in position on the root. Care should be taken in ascertaining that the coping is in its correct position in the impression and provision made for facilitating the detachment and removal of the coping from the cast, by painting it with melted wax previous to pouring the cast.

The cast then should be made of plaster and mounted upon the articulator. When the coping has been detached, cleaned in the acid bath and replaced upon the cast, the facing should be selected and ground to fit the coping at the gingival edge closely, and to meet all other requirements.

The backing then should be placed upon the facing and adapted to the coping. In order to insure a good, close joint between backing and coping, the edge of the backing must come in direct contact with the coping.

If direct contact is secured, the joint between the porcelain facing and the coping will be close in proportion as it may have been ground to fit closely. This will be close enough to insure a joint which will in most cases be more or less invisible when the facing is mounted with cement.

But, where direct contact between backing and coping is not secured, the backing must be extended. Such an extension frequently is necessary,



F

FIG. 159.

and may be made easily. When the backing has been trimmed to the required adaptation to all other surfaces of the facing (Fig. 159 C) a small piece of thin, pure gold (36 gage), or of platinum foil (1-1000) should be tacked to the backing with a tiny bit of solder. When tacked with solder, the extension should be burnished to a close adaptation to the porcelain facing and all surplus trimmed away. (Fig. 159 D.)

In trimming away the surplus, the backing should be finished close to the mesial and distal edges of the facing; but it is always well to leave a slight surplus projecting beyond the facing upon the incisal end. It is well also to reinforce the incisal end of the backing with clasp metal. This reinforced surplus when finished down to the porcelain, after the facing is mounted with cement, will insure a better protection to the porcelain than will obtain if finished close before cementation. (Fig. 159 E.)

Facing and backing now should be placed in proper position on the coping and their relationship sustained securely with melted wax. If the construction is to be completed by the casting process, hard *casting* wax should be used. When the final construction is to be completed by soldering, *adhesive* wax should be used.

When the desired relationship has been sustained in this manner, the crown should be removed from the cast, and the facing detached carefully. Then it should be invested in accordance with the requirements of casting, or of soldering, as indicated. If to be completed by soldering, the investment should be made as illustrated in (Fig. 159 F). When com-

pleted by either method, the facing should be cemented to place, and the crown then finished and polished. (Fig. 159 G.)

In the cementation of the facing, a cement of similar color always should be used.

G

Fig. 159.

Duplicate Replaceable Teeth and Facings.

In the use of replaceable facings, a feature of advantage and importance results from the making of duplicates at the time of construction. In observing this procedure, the duplicate tooth, or facing, should be ground to the proper and required adaptation to the crown just previous to cementing the original. When thus ground and fitted, it should be placed in a convenient form of container, properly labeled and filed away; or, it may be given to and retained by the patient.

Whenever duplicate teeth, or facings, are made, the mold number and the color used always should be a matter of permanent record. In the event of accident, replacement is facilitated.

Use of Flat-Back Facings.

Thin porcelain facings having platinum or platinum alloy pins baked in them are applicable also to the construction of dowel crowns. Facings of this type may be used in either one of two methods:

First: They may be backed properly and attached to the coping by soldering or casting; or, second, they may be backed, removed from the backing while it is being assembled to the coping and attached to the completed crown subsequently by means of cementation. And, if desirable, cementation may be supplemented by riveting the ends of the pins over upon the body of the finished crown.

Because of the advantage to be obtained from the use of replaceable facings cemented to the basic structure, however; and because of the dan-

gers attending the soldering of porcelain facings, together with the weakening of the porcelain; and the elimination of opportunity for replacement in the event of fracture, this type of crown construction is not recommended for universal use.

Application. When this type of facing is used in the construction of dowel crowns, its application can be made best by means of the indirect method. When the casts have been obtained and mounted upon the ar-

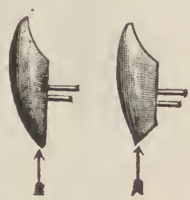


FIG. 160.

ticulator in accordance with an observation of all requirements previously mentioned, the facing should be selected and ground to the proper and desired adaptation. It then should be backed with gold.

Backing. In backing flat-back facings, the incisal end should be ground until a sharp angle is produced. (Fig. 160.) The presentation of a sharp angle along this edge affords a definite finishing line for the backing, and a better protection for the porcelain in the finished crown.

Pure gold, 36 gage, now should be cut somewhat larger than the size of the facing, annealed, perforated to accommodate the pins and burnished to a close adaptation to the facing. All surplus except a slight bit along the incisal end then should be trimmed away. Thin, pure gold is used because of the facility with which a close adaptation may be secured.

In perforating the backing to engage the pins of the facing, care must be exercised in making the perforations. They must be of a size which will fit the diameter of the pins closely. When facings having short, sharp-pointed pins are used, the proper place for the holes may be located by placing the thin, pure gold backing on a pad of soft wood or heavy blotting paper, and pressing the pins entirely through the gold. Or, in the use of facings having pins with blunt ends, the ends of the pins may be pressed firmly against the gold as a means of locating the place for the perforations accurately, and a "plate-punch" then used.

Casting. If the crown is to be completed by the casting process—casting directly to the porcelain—further reinforcement of the backing is

unnecessary; but close apposition of the backing to the facing should be secured and sustained. This is to be accomplished by bending the pins over upon it.

Care should be exercised in bending the pins, and notching them at the desired point with a file, previously, will facilitate bending them. Facing and backing now should be placed in proper relation with the coping, the

Fig. 161.

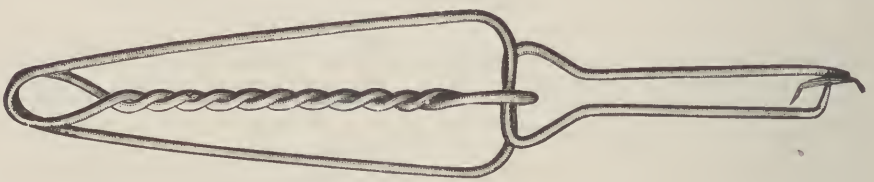


Fig. 162.

relationship sustained with casting wax (Fig. 161 A) and the crown removed from the cast. The contour desired now should be formed with casting wax (Fig. 161 B) the sprue-former attached securely, and the investment and casting completed. (Fig. 161 C.)

If the case is heated to a high temperature before the casting is attempted, and if it is allowed to cool slowly after casting, the danger of fracturing the porcelain facing will be diminished. No advantages are obtained by casting directly to the porcelain, however, and, hence, it is a procedure which is unnecessarily dangerous.

Soldering. When the construction of the crown is to be completed by soldering the facing to the coping, additional reinforcement of the thin, pure gold backing always should be made, previous to soldering.

Reinforced Backings. Adequate and uniform reinforcement may be obtained easily by adapting a second backing made of 22 karat gold, 28 gage or 30 gage in thickness to cover the thin, pure gold backing from and including the pins, to the incisal end. When the second piece of back-

ing has been adapted thus, the two backings should be united with solder. During the soldering, their proper relationship may be sustained by the use of automatic soldering pliers as indicated in Fig. 162. The backings should be united with 22 karat or 20 karat solder. After soldering, the backing should be placed in position upon the facing, (Fig. 163 A) and its relationship sustained by bending the pins (Fig. 163 B). All edges

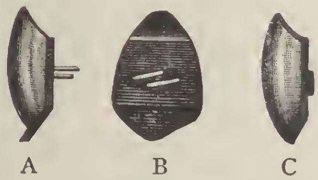


Fig. 163.

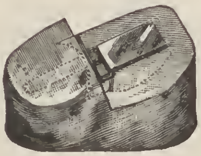


Fig. 164.

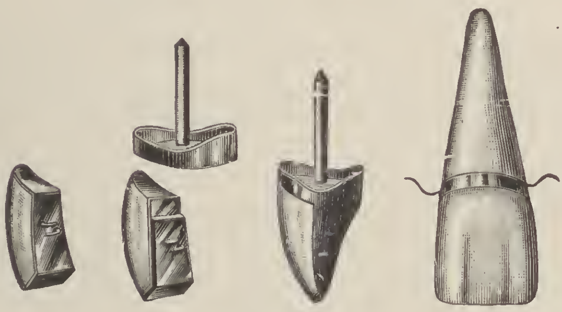


Fig. 165.

of the backing then should be finished down close to the facing until no overhanging edges of gold present. (Fig. 163 C.)

Facing and backing now should be placed in position on the coping, the relationship sustained with adhesive wax, the crown then removed from the cast, invested and soldered. (Fig. 164.) The soldering may be accomplished easily by fluxing the surfaces of gold and heating the case thoroughly before attempting to solder. And soldering may be accomplished with less danger of fracturing the porcelain facing than presents in casting.

The construction of a dowel crown involving a coping having a full peripheral band, the facing backed with a reinforced backing, and the crown completed by soldering is illustrated in Fig. 165.

The requirements of root preparation, the application of a coping having no peripheral band, and the crown completed by soldering are illustrated in Fig. 166.

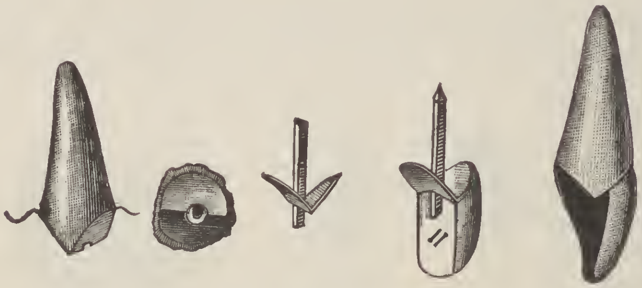


Fig. 166.

Cementing and Riveting.

Since no advantages are to be obtained either from casting or soldering directly to the facing, and since every advantage is to be gained by relieving the porcelain facing from the influences of heating and cooling, and of expansion and contraction, there is but little, if any, excuse for using porcelain facings in this manner.

The objectionable features are overcome, and all of the desirable features of a replaceable cemented facing gained by the use of flat-back facings retained in their relationship to the basic structure: first, by means of cementation only; and, second, by means of riveting the surplus ends of the pins to the surface of the finished crown.

In the use of flat-back facings which are to be sustained to the basic structure by cementing or by riveting, all the advantages of a replaceable facing may be secured, and are applicable to the construction of the crown, either by casting or by soldering. The "Lockit Cups" which are illustrated in connection with the use of flat-back facings in the construction of posterior pontics for bridgework are useful.

Casting. In this procedure, if the construction of the crown is to be carried through by the casting process, a single thickness of backing made of thin, pure gold should be adapted to the facing without bending the pins over upon it. (Fig. 167 A.) With the facing and backing in proper position in relation to the coping, the pins should be lubricated with oil or vaseline and hard casting wax then melted over and around them, and against the backing, and the desired form and contour made.

The facing then should be detached from the backing and coping carefully. Small graphite points now should be inserted through the holes in the backing and to the full depth of the holes in the wax. (Fig. 167 B.) A slight surplus may be allowed to project beyond the backing. The sprue-former now should be attached securely (Fig. 167 C) and the crown in-

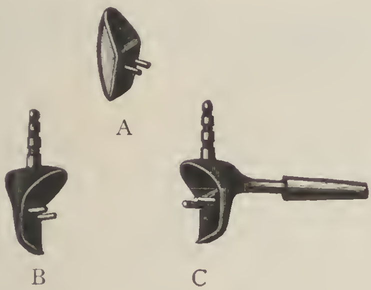


Fig. 167.

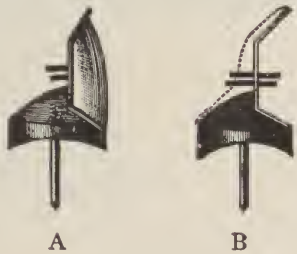


Fig. 168.

vested and cast. After the casting has been made, boiling in dilute hydrochloric acid will remove the graphite points. The crown then may be finished and the facing cemented to place subsequently. As a means of insuring a secure attachment of the cement, the pins may be notched with a file, or threaded with a tap made for the purpose.

Soldering and Riveting. Where it is desirable to construct the crown through soldering the backing to the coping, instead of casting, the facings always should be backed with a reinforced backing in the manner described previously. A reinforced backing is the only means of insuring a uniform thickness and adequate strength in the backing along its edges.

When backed properly, without bending the pins, facing and backing should be placed in position on the coping and the relation sustained with adhesive wax. (Fig. 168 A.) The facing then should be detached and removed, and graphite points placed through the holes in the backing as indicated in Fig. 168 B. The crown now should be invested and soldered, the required contour being obtained at the same time. When the soldering has been completed, the graphite points may be removed with acid, the crown then roughly finished and the facing fitted to place. The ends of the pins may, or may not, project through the body of the crown. If they do not project through, the facing may be attached securely by cementation only. If they do project through, the attachment may be made

doubly secure by riveting their exposed ends down close to the surface of the crown.

The process of riveting may be accomplished easily by investing the crown first in a large base of plaster, as indicated in Fig. 169. When this

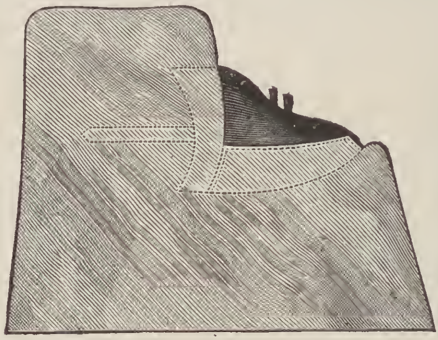


Fig. 169.

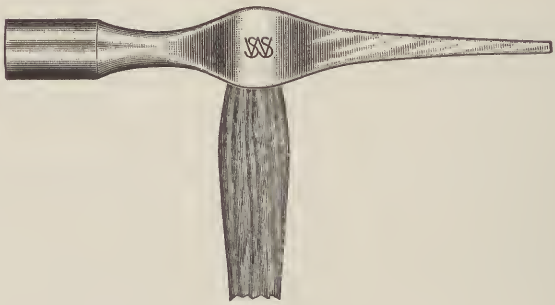


Fig. 170.

is crystallized thoroughly the riveting may be accomplished with a small riveting hammer. (Fig. 170.) If used carefully, any danger of fracturing the porcelain facing is overcome by the support and protection offered by the plaster investment. When the riveting has been completed the crown may be finished and polished.

Temporary Dowel Crowns.

In the construction of dowel crowns, the use of some simple form or type of temporary crown is indicated frequently. The application serves a double purpose.

A temporary crown, mounted with gutta-percha or temporary stopping, either of which is satisfactory as a mounting medium, compresses the investing tissues and affords a free exposure of the root-end and

an immediate, though temporary, relief from disfigurement in emergencies. Both are desirable features.

To obtain a good adaptation of the coping for a dowel crown without first compressing the investing tissues and obtaining a free exposure of the root-end is difficult in all cases and impossible in many others.

FIG. 171.

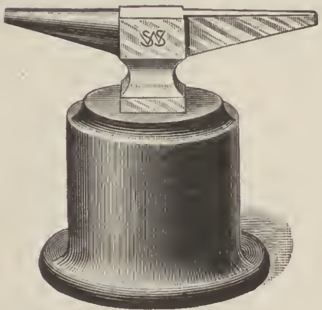


FIG. 172

To dismiss a patient with a missing anterior tooth during the construction of a crown restoration is almost criminal negligence. Or, to be unable to afford relief from temporary disfigurement, in emergencies, is an acknowledgment of limited skilful resources.

The simplest form of temporary crown, yet one which is most useful, may be made by using a flat-back facing, and attaching a dowel only. If one is provided with a limited selection of flat-back facings for the six anterior teeth, and with a few dowels made of 14 gage, round German silver wire, a temporary crown, which will answer the purpose nicely, may be constructed in a few moments. German silver wire in all sizes may be procured from dental and jewelers' supply houses. (Fig. 171.)

In this procedure, a facing which will approximate the requirements of esthetics should be selected. When the selection has been made, a dowel should be made and fitted to it. A length of 14 gage round wire adequate to the requirements of the case should be cut. The end which is to engage in the root canal should be tapered to fit the supporting root. It then should be annealed and the other end made flat and sufficiently broad to accommodate the position of the pins in the facing, when it has been

notched with a file for this purpose. This end may be formed, thus, with a hammer on a swaging block, or on a small laboratory anvil. (Fig. 172.) When it has been flattened and then notched to fit the pins closely, relationship between dowel and facing may be sustained securely by bending the pins over upon the wire, as illustrated in sequence in Fig. 173.

If this mechanical attachment between facing and dowel does not appear to insure adequate strength, facing and dowel may be invested, heated

Fig. 173.

carefully, and soldered. A low grade of gold solder, silver solder, or even soft solder, will answer the purpose.

Any of the manufactured or ready-made porcelain crowns, either with dowels united or separable, also may be used to good advantage for temporary purposes.

Ready-Made, All-Porcelain Dowel Crowns.

Several types of ready-made, all-porcelain dowel crowns are manufactured and may be used successfully. They are made with the dowel as an integral part of the crown, and with the dowel as a detached or separable part. A coping may or may not be used.

When a coping is not used, the requirements of adaptation are obtained by grinding the basal end of the crown to fit both the basal end and the periphery of the root. No greater accuracy is possible than the limited accuracy which is to be obtained through grinding one surface to fit another surface. Hence, a maximum of protection to the supporting root, and a maximum of permanency in the restoration is not obtainable, usually, nor is it to be expected through the use of ready-made, all-porcelain dowel crowns.

The type of crown in which the dowel is baked into the body of the crown, and thus is an integral part of it, was among the early achievements in porcelain dowel-crown construction. (Fig. 174.)

The difficulty in obtaining accuracy in the adaptation of the crown to the root, by grinding, is increased by the presence of an inseparable dowel. And this feature, together with the difficulty of obtaining an alinement with the crowns of the adjacent natural teeth without unnec-

essarily and, in some instances, greatly weakening the supporting root, have caused the practical abandonment of this type of crown, and the general use of crowns having separable, or detached, dowels.

Indications. The use of ready-made, all-porcelain crowns adapted to the supporting root by grinding, and used without any form of coping, does not usually insure a maximum of permanency in the restoration.

FIG. 174.

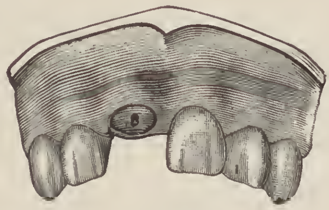


FIG. 175.

Hence, this type of crown is indicated mainly in the restoration of roots where great permanency is not demanded or is not expected.

Requirements. The health of the supporting root and of its investing tissues and the permanency of the restoration will depend entirely upon the accuracy of adaptation obtaining between crown and root at the line of junction and around the entire circumference—and will increase accordingly.

Therefore it is evident that a good, close joint between the basal end of the crown and the basal end of the root must be made in order that a minimum of cement in the joint may be exposed to the action of the secretions. And it is evident, also, that the continuity of the root must be preserved by a close adaptation of the crown to its periphery in order that no irritation of the investing tissues may be offered.

Application. In the application of ready-made, all-porcelain dowel crowns, the selection of the crown will be facilitated by taking a simple impression of the root first, including several adjacent teeth, with baseplate wax, and obtaining a plaster cast. (Fig. 175.)

Selection of Crown. With a more or less accurate plaster cast as a guide, a crown which meets all requirements should be selected. Color, type, size, contact and alinement, together with a basal end which approximates in size and shape the basal end of the root, must be considered in making the selection.

If it is not possible to obtain a selection which approximates the size and shape of the basal end of the root, a larger, but never smaller, size

should be selected. A crown of larger basal-end proportions may be ground to a joint closely approximating the periphery of the supporting root, but one which is too small never can be adapted to a satisfactory degree of accuracy.

Adaptation to Root. When a suitable crown has been selected, it should be ground slowly and carefully until the desired and required adaptation is obtained. The use of lampblack, mixed into a paste with vaseline, and painted on the basal end of the root, will aid materially in effecting a good, close adaptation.

Increased Accuracy. Increased accuracy in the adaptation of the crown to the periphery of the root may be secured by first taking a single unit impression of the root-end in impression compound, and making an amalgam cast.

The amalgam cast should be formed in the shape of a conical root of sufficient proportions to insure its retention in a plaster cast which is to be made subsequently.

When the amalgam cast has crystallized, it should be finished roughly and the labial or buccal surfaces indicated or designated by a definite marking.

An impression of the root, together with the crowns of the adjacent natural teeth then should be taken with base-plate wax. The amalgam cast of the root now should be placed in its proper position in the wax impression, and sustained securely with melted wax. A plaster cast then should be made. When the cast has been obtained, the amalgam reproduction of the root-end should be exposed freely by trimming away the surrounding edge of plaster.

The desired adjustment of the porcelain crown to the amalgam cast of the root-end, and the requirements of alinement with adjacent teeth, may be made then with greater accuracy than probably would be obtained from an effort to accomplish the adjustment directly in the mouth. This is possible because all surfaces of the amalgam cast of the root-end are fully visible, and because opportunity for correct alinement exists at the same time.

Final adaptation and adjustment may be made directly upon the root. The dowel then should be adjusted to meet the requirements, and the crown mounted.

Since the successful application of ready-made porcelain crowns depends entirely upon the degree of accuracy obtained in their adaptation to the supporting root, any effort which will insure greater accuracy will add materially to permanency.

CHAPTER XIII.

PORCELAIN CROWNS.

Ceramics is the highest achievement in modern dental art. From the time of the introduction of "mineral" teeth, first suggested by Fauchard and later by Duchateau, to the present time, the possibilities of porcelain work have been recognized.

As a means of simulating closely the natural teeth in color, form and texture, and as a means of attaining the highest requirements in the direction of hygiene and sanitation, and, therefore, in the conservation and promotion of health, porcelain work stands preeminent. It stands alone.

The primitive application of porcelain was made to the restoration of the crowns of teeth as single units. These restorations were known as "pivot" crowns. This was followed by the application of porcelain to denture construction.

The discovery that various minerals might be combined and made to form a compound which would be applicable and controllable, and which would possess and afford all the desired esthetic and hygienic advantages in the reproduction of the natural teeth, as single units, led to further experimentation with a view to producing a color which would simulate closely the color of the contiguous soft tissues.

The color problem soon was mastered successfully and no vegetable compound yet discovered even approaches the close simulation to the color of the soft tissues which can be obtained with porcelain.

The problem of color having been mastered successfully, further development resulted in the control of fusibility, and in obtaining successfully and retaining permanently a given form or shape. The latter requirements were made possible by the use of platinum. This member of the small group of noble metals is adapted peculiarly to the requirements of porcelain work. It possesses the desired and required physical properties of malleability and high fusibility. Its malleability permits accuracy of adaptation, and retention of given form and shape. And its high fusibility, irrespective of thickness, permits it to withstand the varying degrees of temperature required by high-fusing porcelain compounds.

Originally, porcelain compounds were made in two grades only. One grade was known as "foundation body" and the other was designated as "enamel body." The foundation body was the same as was used in making porcelain teeth, and the enamel bodies were pink in color and fused at a temperature lower than that required to fuse the foundation body.

Full porcelain dentures made upon a base of platinum were suggested and perfected by and through the early efforts of Dr. John Allen and Dr. S. L. Close. This type of artificial denture became known as "continuous gum" work, and, in many respects, continuous gum dentures afford the highest and most ideal type of construction.

The early efforts in fusing these compounds were confined to the use of a coke furnace and a bellows. This crude method of heat production required considerable effort and much time and usually was done at night.

The successful application of porcelain, in combination with a base of platinum, to denture construction was followed by the advent of the porcelain jacket crown made upon a platinum matrix, as orginally suggested and perfected by Dr. C. H. Land. The matrix was and is used only for the purpose of insuring accuracy of adaptation and retention of form, and subsequently is stripped off or removed entirely. And, originally, when various colors were desired they were obtained by breaking and pulverizing porcelain teeth of proper color.

The advantages obtaining from the successful application of porcelain to denture construction, and, later, to jacket crown restorations, were soon recognized as being of such importance as to demand better facilities for baking or fusing porcelain compounds, and as possessing such desirable features as to warrant a more general application to the field of crown and bridgework.

The use of gas and gasoline furnaces followed, and while these methods of heat production were an improvement upon the former primitive method, the noise and odor incident to their use was objectionable. Furthermore, the integrity of the porcelain and the preservation of its color were endangered always by the possibilities of "gassing" or of gas contamination.

The ingenuity of the profession, however, soon proved equal to the demands, and the advent of the electric furnace followed. This refined method of heat production was the missing link, and the electric furnace has eliminated all former objectionable features and dangers incident to fusing porcelain and now is used exclusively.

Porcelain compounds were improved correspondingly and now are made in several grades, with different degrees of fusibility and in varying colors.

With these improvements in materials and in facilities, the scope of porcelain work became enlarged, and its application to the construction of dowel crowns, and to all forms of bridgework followed.

As applied to the construction of dowel crowns with platinum coping and porcelain facing, the application of porcelain was and is more or less successful.

The application of porcelain to bridgework, however, was more or less disastrous. Early efforts proved unsuccessful because porcelain is a friable substance, and even though supported and protected by a strong and well-built platinum superstructure, it is not applicable universally.

Failure, however, was attributable to injudicious application, or to faulty technic, or both, perhaps more than to the inherent weakness of the porcelain itself.

There is no legerdemain, no wizardry, about porcelain work. Its successful application is but a question of skill; nothing more, nothing less. It has passed through the experimental stages and now is recognized as a necessary and permanent part of modern dentistry; and as being an art encompassing a field of usefulness almost unlimited in scope.

Jacket Crowns.

The porcelain jacket crown is the most ideal type of crown restoration. It stands to-day and must stand always as the one ideal method of restoring the crown of a natural tooth as a single unit. From all viewpoints it meets all requirements to an extent which completely overshadows all other methods and to such an extent that the author of this book feels it a duty to broadcast its advantages to the limit of his ability; and to indulge and express the wish that some day it might be possible to use no other type of crown in effecting the restoration of the natural teeth.

If the all-porcelain jacket crown might be used universally, and to the exclusion of all other methods of crown restoration, dental art would be placed upon a higher plane; dental skill would be of an order immeasurably higher, and greater health of teeth and of investing and environmental tissues would obtain, and would be maintained.

Advantages. The advantages obtainable from the use of all-porcelain jacket crowns may be enumerated, specifically, as follows:

First: *Esthetic.*

The possibilities for reproducing tooth-form and color with exactness, and for simulating type and characteristics with artistry and accuracy are limited only by the skill which may be acquired, developed and displayed along these directions.

Second: *Hygiene and Sanitation.*

Porcelain being a *vitreous* substance, it presents a surface when fused, which is absolutely non-irritating and non-absorptive, and, hence, a surface which is kept clean easily.

Third: *Promotion and Maintenance of Health.*

It is recognized that the investing tissues take more kindly to porcelain than to gold or platinum. Hence, any degree of mechanical irritation is unnecessary and may be eliminated entirely in proportion as accuracy of adaptation may obtain. And in proportion as the possibilities of irritation may be eliminated, the health of these tissues will be promoted and maintained.

Fourth: *Pulp Conservation.*

The application of porcelain jacket crowns permits pulp conservation and the advantages of pulp conservation are recognized as among the most important considerations incident to the restoration of the crowns of teeth.

Fifth: *Non-conductivity.*

Porcelain being a good non-conductor of thermal changes, the possibilities of shock to the nerve and blood supply of the pulp, with its possible devastating influence, is eliminated entirely.

Sixth: *Influence of Light.*

The influence of light is recognized as exercising a normal stimulation to the vitality of the tooth pulp. Porcelain is translucent; and, while jacket crowns are mounted with cement, which is not translucent, but which is opaque, translucency is not overcome entirely by the opaqueness of the cement used in mounting because of the thinness of the layer intervening between the porcelain and the pulp. Hence, the possible stimulating influence of light, while diminished, is not overcome entirely.

Seventh: *Masticatory Efficiency.*

Masticatory efficiency is an important consideration in the restoration of the crowns of the posterior teeth, particularly, and a surface of porcelain is recognized as affording greater efficiency than is afforded by a surface of gold. Gold, whether finished roughly or polished highly, will wear smooth, while porcelain is not so susceptible to the influence of continued attrition.

Eighth: *Strength.*

Porcelain, by no means, is indestructible, nor is it as inherently strong as gold. And, yet, a degree of strength adequate to the requirements of stress may be obtained from the use of high-fusing compounds. Adequate strength will be secured provided first, that the supporting tooth is pre-

pared properly; second, that the porcelain is not overfused; and, third, that functional occlusion is insured.

Indications. Cases may and do present where the requirements of occlusion demand absolute indestructibility in the restoration, and where proper preparation of the supporting tooth to receive and sustain a porcelain jacket crown is inadvisable or impossible.

In such cases some other method of restoration is indicated, may be preferable, or may be demanded. But, with these exceptions, porcelain jacket crowns are applicable more or less universally.

They are applicable to the restoration of posterior teeth as well as to anterior teeth, and they are applicable to pulpless teeth, as well as to teeth having vital pulps. Their use is indicated, therefore, in the restorations of the crowns of all teeth when the restoration is to be made as a single unit, and when skill equal to the requirements has been developed.

Requirements. In the building of porcelain jacket crowns, several basic requirements are essential to successful achievement. These are as follows:

First: *Detail.*

It must be recognized that exactness in technic is demanded. The development of skill in porcelain work is simply a question of ambition and of application, combined with a recognition and appreciation of the fact that exactness in technic must be observed, in sequence, from the beginning to the end of the procedure.

Second: *Preparation of Supporting Tooth.*

It must be observed that the supporting tooth is prepared properly. Where the root preparation involves the making of a shoulder the requirements, as indicated previously, demand that the shoulder be formed definitely and properly; that it be placed well within the gingival border, be smooth and continuous, and that no undercuts present. If undercuts do present, they must be filled with cement and polished until smooth surfaces obtain.

Third: *Stress.*

A study of the adjacent natural teeth, of the opposing teeth, and of the demands of occlusion, constitute a basic requirement. This is essential in order that the requirements of stress may be adequately met from the viewpoint of each individual case.

Fourth: *Type.*

A study of the type and characteristics of the adjacent and opposing teeth must be made in each case. This is necessary in order that the res-

toration may simulate closely the natural teeth in all of their characteristic features.

Fifth: *Color.*

The Color Problem.

A fundamental knowledge of the phenomena of color is essential to the achievement of the highest possibilities in esthetics. This scientific and exacting problem is an interesting study, and a knowledge of the physical manifestations of color, of the interpretation of colors, and of the psychology of color vision will be helpful in the application of porcelain work to any of its fields of usefulness.

In the development of skill and in the accomplishment of successful results, it is necessary to know, fundamentally at least, that sunlight is the greatest source of illumination; that it is a white light; that it is the most perfect light, and that it is the source of all color; and, therefore, the standard by which color is judged.

It is necessary, also, to know that sunlight is composed of the color rays of all colors, and that the physical manifestations of color is produced by the reflection of certain rays of light not absorbed by the object, and that these reflected rays are perceived as a distinct color.

It is necessary to know, furthermore, that the interpretation of color depends upon at least three varying conditions:

First, intensity; second, phenomena in the body itself; and, third, the individual peculiarities of the eye which views.

Thus, briefly, in proportion as sunlight is diminished in intensity, color appears darker and is interpreted differently; also, when viewed under the rays of any illuminant other than sunlight, the rays being different, the reflection is different, and, hence, the color is different.

It is observed, also, that the phenomena in the body itself control its color, and that the same object, whether transparent, translucent, or opaque, may be made to appear different by diminishing its thickness, or by altering its surface condition. And that a rough, or an uneven, or irregular surface always appears darker than a surface which is smooth and highly polished.

It is found, too, that the difference in refraction in individuals, and the variations at different ages, are important considerations, and that it is estimated that at least five per cent. of the human race is "color blind."

All of these considerations have an important bearing upon the interpretation of color, and cause the problem of color to be a difficult one. Hence the matching, the production and the reproduction of color or of

colors is a question largely of individuality. Therefore no standard rules which will be applicable universally may be formulated.

However, certain definite rules for obtaining, or matching, color are applicable to all, and should be observed carefully. These are as follows:

First: Good light is essential to accurate color selection.

Second: The patient should be placed in the proper position in relation to the source of light.

Third: The teeth to be matched must be clean and free from stains.

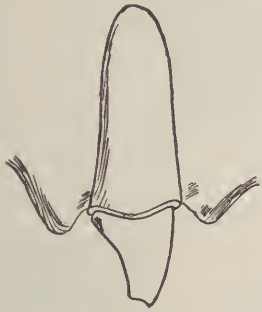


Fig. 176.

Fig. 177.

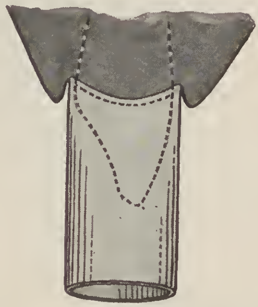


Fig. 178.

Fourth: Any and all discoloration caused by caries should be removed.

Fifth: The teeth to be matched should not be dry.

Sixth: There are two colors in almost every tooth; both should be matched.

Seventh: One must know and be a master of the colors with which he works.

Technics of Construction.

Many methods of procedure are followed in the technic of building porcelain jacket crowns. Almost every skilful craftsman develops and adopts a technic which is suited best to himself, and from and by which he can obtain the best and most certain results, without waste of time.

It is results, in the composite, which count in the end, and the method of procedure followed in obtaining the result is of interest and importance to others, only in proportion as it may be applied and utilized by others. Hence, a technic which may be followed successfully by the greatest number, and which will insure uniformly successful results in the largest proportion of cases should be followed.

No effort to save time at the expense of results, or at the expense of accuracy and certainty, ever should be made.

Impressions and Casts. Porcelain jacket crowns must be built by the indirect method. Hence, good, reliable impressions and good accurate casts are the first essentials to success.

Unit Impression. A unit impression of the tooth, or root, must be obtained first. When the preparation has been completed satisfactorily

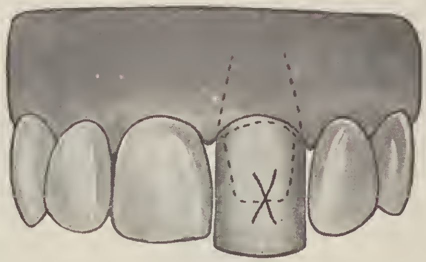


Fig. 179.

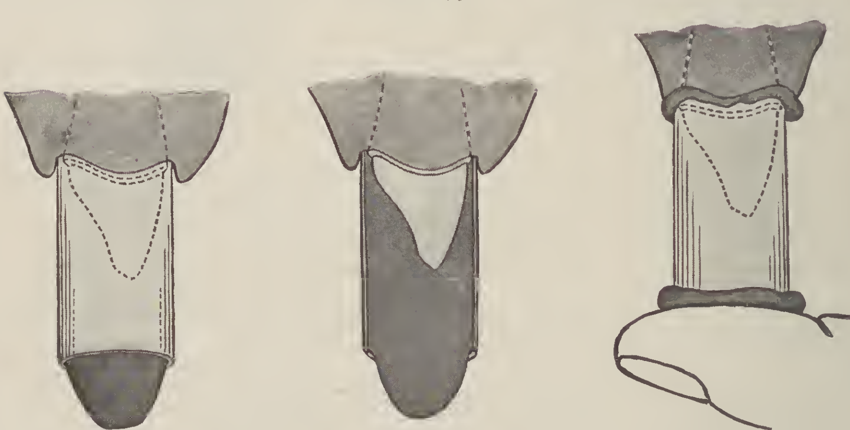


Fig. 180. Fig. 181.

as illustrated typically in Fig. 176, an impression band (Fig. 177) made of copper or aluminum, should be selected and fitted. It should be fitted so that it will pass freely over the shoulder and should be trimmed to follow the gingival curvature closely; and this should be done before the shoulder is formed. (Fig. 178.) A mark to designate the labial or buccal surface then should be made. (Fig. 179.) The band should be filled with hard, stick impression compound, softened over a flame. The impression then should be taken by forcing band and softened compound over the tooth firmly. (Fig. 180.) When well seated, with a slight surplus of compound showing around all surfaces (Fig. 181), it should be chilled with a

spray of cold water, and then removed. If a good imprint of the shoulder around the entire circumference presents (Fig. 182), the impression is satisfactory. If a good imprint does not present, the compound must be reheated and the procedure repeated until a good impression is obtained.

When a satisfactory unit impression has been obtained, a small piece of impression compound, or of temporary stopping, should be softened in the flame and molded over the tooth to form a coping. This coping should

FIG. 182.

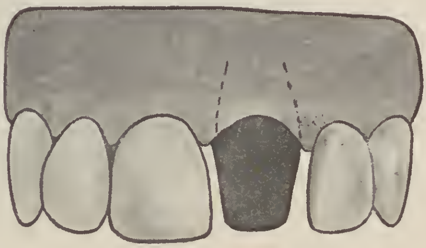


FIG. 183.

cover all of the exposed tooth surfaces, but should not come in contact with the crowns of the adjacent teeth. (Fig. 183.)

Impression of Adjacent Teeth. An impression, including several adjacent teeth on either side, now should be taken with the coping made of compound or temporary stopping, in position on the tooth. Plaster or baseplate wax may be used for the impression. Plaster is much more accurate and reliable and, therefore, is preferable. When the impression is removed, the coping will come away with it.

Taking the Bite. The bite now should be taken in base-plate wax. This procedure may be effected in the best manner by lubricating the interior surfaces of an adjustable partial impression tray with oil, glycerin, or vaseline, filling the tray with base-plate wax of proper plasticity, and then forcing it to place over the *opposing* teeth. A good imprint, which is desirable, thus is obtained of the opposing teeth. The tray should be removed from the wax immediately, and, while the wax is still soft, the patient should be instructed to close firmly. Then, by pressing the wax with the fingers firmly against the labial or buccal surfaces of the adjacent teeth, and instructing the patient to do likewise upon the lingual surfaces with the tongue, and observing that the teeth are held firmly in centric occlusion a good, accurate bite results.

While the use of an impression tray in taking the bite is not absolutely necessary, still, a good, deep imprint of the crowns of the opposing teeth

insures a good reproduction of these teeth in the cast, and a good reproduction of the opposing teeth, however it may be obtained and insured, is desirable always.

The selection of color and the temporary protection of the prepared tooth now should follow.

Fig. 184 A.

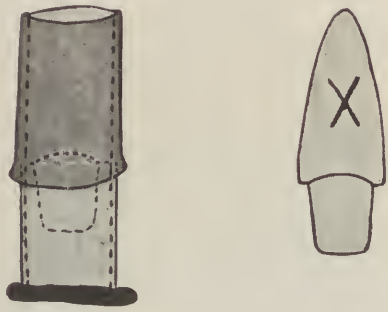
Fig. 184 B.

Temporary Protection. The temporary protection of the tooth, or root, and the compression of the gingival tissues during the period required to build the crown, is important.

In posterior teeth this may be accomplished satisfactorily by packing temporary stopping over the exposed tooth tightly, and molding it to fill the space and to preserve the alinement between the adjacent natural teeth. This same procedure is applicable also to the anterior teeth, but an equally useful and a more esthetic result may be secured easily and quickly by making a temporary restoration with the silicate cements.

Silicate Cement Crowns. Thin, transparent tooth-crown forms, made of celluloid, are useful for this purpose. In the use of these forms, one which will meet the requirements of the case should be selected, trimmed and fitted. (Fig. 184, A.) Silicate cement of the proper color now should be mixed in the proper consistency and packed tight into

the celluloid form. The exposed surfaces of the tooth then should be lubricated slightly to facilitate the subsequent removal, and the form filled with silicate and then forced to place over the tooth. When the silicate has become thoroughly crystallized, the celluloid form may be removed by cutting it with a thin, sharp blade. The requirements of



A B

Fig. 185.

occlusion now should be noted carefully, and any necessary change in form or contour made. (Fig. 184, B.) Such crowns may be worn more or less indefinitely, and, because of having used a lubricant previous to mounting, they are removed easily at any time.

Crown restorations made of the silicate cements and formed in this manner are recommended for permanent restorations by the manufacturers of these products, but some doubt as to the permanency of form and color prevails.

Where restorations are made in this manner with a view to obtaining whatever degree of permanency the procedure may afford, the supporting tooth should not be lubricated, but should be dried thoroughly and then covered with a thin layer of ordinary crown and bridge cement previous to mounting. For the reason that silicate cements are not adhesive, the use of cement is advantageous.

Obtaining the Casts. When the unit impression, the impression of the adjacent teeth and the bite have been obtained, and when the tooth has been protected, as indicated, the work then is transferred to the laboratory.

Amalgam Cast. An amalgam cast of the tooth should be made first. To make this the unit impression should be surrounded with a rim of thin, sheet wax in such manner as to form a matrix for building and

forming the amalgam cast. The wax rim should be of a width which will afford a root-end extension to the cast. (Fig. 185 A.) This now should be invested in plaster even with the edge of the wax rim. When the plaster has crystallized, the impression should be filled with amalgam, packed carefully and firmly.

Quick-setting amalgam alloys are prepared for this and other laboratory purposes. Cement is used also for making the unit cast, but cement is not indestructible, and, hence, is not accurate nor reliable.

Fig. 186.

When the amalgam has crystallized thoroughly, the plaster investment should be broken away, using a sharp blade and a hammer. Impression and cast should be placed in hot water and separated. The root extension then should be trimmed down with disks until a typical root of conical formation, with a mark to designate the center of the labial or buccal surface is secured. (Fig. 185 B.) No undercuts along any of the surfaces should present and finishing to the point of polishing is advantageous.

Plaster Casts. When the amalgam cast has been finished, and when the plaster impression has been varnished, the cast should be placed in correct position in the impression. The coping of compound or temporary stopping, which is a part of the impression, will permit of its accurate placement, since it was made and is used for this purpose exclusively. (Fig. 186.) The relationship should be sustained securely with melted wax, and the cast poured with plaster. When separated, the compound or temporary stopping coping should be heated slowly and removed care-

fully. The bite now should be adjusted carefully and the case mounted upon the articulator.

Indestructible Surfaces. Indestructible surfaces in the reproduction of the crowns of the adjacent teeth, as a part of the plaster cast, may be

FIG. 187.

FIG. 188.

obtained easily, and add materially to the accuracy of the cast, and thus to the accuracy of the work being built upon it.

This advantage applies particularly to the mesial and distal surfaces and contact points of the teeth immediately adjacent to the restoration. It is obtained by filling the imprint of these teeth in the impression with amalgam, and permitting the amalgam to crystallize before pouring the cast.

When this procedure is to be followed, quick-setting amalgam alloy should be packed carefully and firmly into the imprints of the crowns of the adjacent teeth, after the impression has been varnished. While the amalgam is still plastic, the head of an ordinary pin should be imbedded into the amalgam in the center of each tooth. The pin will become attached to the amalgam and will sustain it securely in its relationship to the cast. (Fig. 187.)

After the amalgam has crystallized, the cast should be poured with plaster. When separated, the cast presents an accurate and indestructible reproduction of the crowns of the adjacent teeth. (Fig. 188.) Casts made in this manner insure accuracy at all times, and should be used invariably.

When the casts have been mounted upon the articulator, and the wax bite removed, the amalgam cast of the root should be detached from the plaster cast in such manner as to permit of its replacement with accuracy. Casts thus obtained present all the advantages of indestructibility and of increased accuracy.

In building bicuspid and molar restorations, the reproduction of the occlusal surfaces of the opposing teeth may be made in the same manner, and such procedure will afford the same advantages.

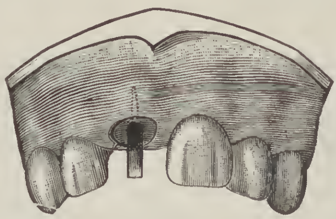


Fig. 189.

Restoring Pulpless Teeth.

Porcelain jacket crowns, with a shoulder, also are applicable to the restoration of the roots of teeth the crowns of which have been sacrificed previously, or which must be sacrificed to the gingival line, and restorations so made present all of the advantageous features which have been mentioned. Indeed, such restorations are made even more easily because the requirements of root preparation are not so exacting, and the formation of a shoulder is simplified.

In the restoration of the roots of teeth where the natural crowns have been, or must be sacrificed to the gingival line, however, a restoration approximating the normal outlines of the dentin should be made previous to, and independent of, the porcelain crown restoration itself.

Making Cones. Such restorations are called "cones" and may be made by the casting process, either of gold or silver. The use of gold alloy similar to that used for casting crowns and inlays, however, is recommended, and such restoration can be made best by the indirect method.

Indirect Method. In making a cone it is necessary to observe, first, that the margins of the basal end of the root are carried to a point within the gingival border.

The canal should be prepared and a dowel made of iridio-platinum or high-fusing clasp-metal alloy and then fitted. The dowel should extend into the canal to a depth adequate to the requirements of strength, with a surplus end projecting incisally or occlusally to a considerable extent, but always free from contact with the opposing teeth. (Fig. 189.)

An impression band now should be fitted to the root and trimmed and marked as indicated. It should be observed also that the band does not interfere with the opposing teeth. The unit impression of the root, with the dowel in place, then should be taken in the manner indicated.

When a satisfactory unit impression has been obtained, the bite should be taken in base-plate wax with the unit impression in place. Following the bite, the impression of the adjacent teeth should be taken in plaster, or base-plate wax, also with the unit impression in place. Both will be removed together.

The unit impression, with the dowel in place, now should be detached and removed from the plaster impression and the amalgam cast of the root made separately. To prevent the dowel from becoming attached to the amalgam cast which is built over and around it, the dowel should be painted with melted wax before packing the amalgam. This precaution will prevent attachment by amalgamation, or disintegration by mercury, and permit of the removal of the dowel from the amalgam cast subsequently. In forming the amalgam cast, the root extension should be made conical in shape, and undercuts should be avoided.

When the amalgam has crystallized it should not be separated from the impression, but, still attached, both should be placed in accurate position in the plaster impression and the cast poured with plaster. After separating the plaster cast from the impression, the bite should be adjusted and the case mounted upon the articulator.

The taking of a bite and the making of occluding casts is necessary always in building restorations for the posterior teeth, but not always necessary in anterior teeth.

When the casts have been obtained, the impression band and impression compound should be warmed and removed carefully. The dowel now should be warmed, detached, and cleaned in the acid bath; then replaced.

A cone of desired shape and form, and which will leave a sufficient width of tooth surface exposed to form a shoulder around the entire circumference should be made over and around the exposed end of the dowel, with casting wax. The cone must be made of a shape favorable

to the requirements of the porcelain jacket crown which is to be made over it; and accommodation for an adequate thickness of porcelain must be provided.

When so formed, the sprue-former should be attached securely, and the investment and casting made. When the casting has been made, it

Fig. 190.

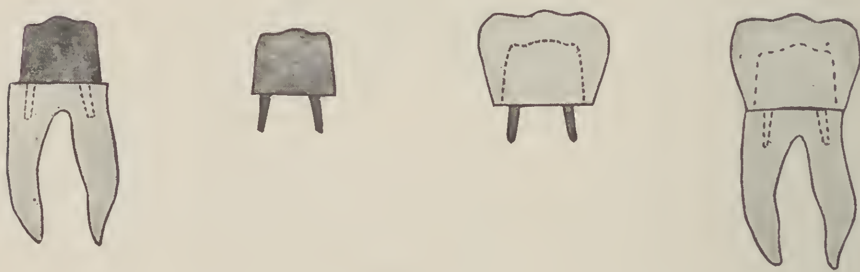


Fig. 191.

should be finished and polished, then placed in position on the cast, and the porcelain crown built.

While greater accuracy may be obtained by making the cone by the indirect method, the direct method may be used successfully in restoring the anterior teeth particularly.

Direct Method. Where the direct method is to be followed, the restoration, or cone, should be made first with casting wax directly upon the root and with the dowel in position. When trimmed and formed to the desired outlines, the casting should be made, finished and polished. It is then placed in position on the root, the impressions and bite taken, the casts obtained and the porcelain crown made. The same procedure which is followed where the natural tooth crown remains is observed. When the porcelain crown is completed, cone and crown are mounted at

the same time. The steps in order and in detail for anterior teeth are illustrated in Fig. 190, and for posterior teeth in Fig. 191.

Making the Matrix. Platinum foil, 1-1000, is used for the matrix. The formation or adaptation of the matrix to the amalgam cast may be obtained by burnishing or by swaging.

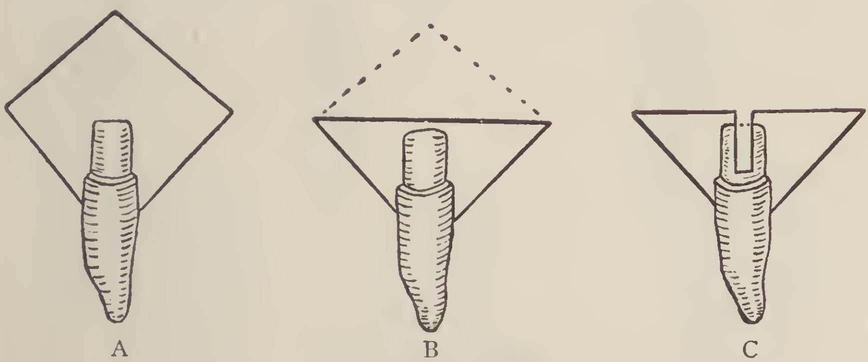


Fig. 192.

If the adaptation is to be made by swaging, the amalgam cast should be imbedded in a ring filled with impression compound, leaving only the crown and shoulder exposed freely. Any of the crown swaging presses, or cylinders, which include a plunger of soft rubber may be used.

Burnishing, however, is productive of results which are equally accurate, and the procedure is simpler.

In obtaining the formation of the matrix for the anterior teeth by burnishing, a piece of platinum foil of proper proportions should be cut of rhomboidal shape (in the form of a diamond) with the greatest diameter mesiodistally. (Fig. 192 A.)

Holding the amalgam cast in the fingers, place one of the shorter points at the center of the labial, or buccal, surface of the cast, well up on the root, and freely beyond the shoulder. Then fold the opposite point over the lingual surface of the cast, and burnish with the fingers until the outline of the shoulder around the entire circumference obtains. Then hold the finger firmly against the foil and cast upon the labial or buccal surface; sustain their relation and open the matrix.

Then cut off the excess as indicated in Fig. 192 B, and cut a slit at the mesial and distal angles of the labial surface to a point approximating the incisal angle. Now fold this central flap over the incisal end (Fig. 192 C) to the lingual surface of the cast, and then again close the lateral wings of the matrix around the shoulder.

Bring the ends of these wings together with foil pliers, and cut off the excess, leaving enough excess, however, to make a double lap. Now remove from the cast and cut away all unnecessary gingival excess, allowing a surplus of about two millimeters to project beyond the shoulder

A B C

Fig. 193.

Fig. 194.

Then replace the matrix upon the cast and complete the burnishing, using wood points and blunt-end instruments.

Complete the burnishing upon the labial surface first, and burnish always toward the joint. When well adapted, the surplus ends at the joint should be pulled together tight, and then lapped over again in the same direction in which the flaps were folded originally. (Fig. 193 A.)

This double lapping of the surplus at the joint is necessary as a means of sustaining the form and shape of the completed matrix. Any unnecessary surplus presenting upon the lingual surface, and due to the concave outlines of this surface, may be cut away before the final burnishing, and the thickness of the joint at the shoulder (Fig. 193 B) may be diminished with a small, fine-grit stone.

The completed matrix, showing the extent of surplus which should be permitted to overlap the shoulder, and which is necessary as a means of guarding against any change of form which might be caused by shrinkage in the fusing of the porcelain is illustrated in Fig. 193 C.

In adapting the matrix to bicuspids and molars, the same procedure is followed except that a strip of platinum foil of proper size, and having straight edges, is used to begin with, and that a slit is cut at every one of the *four* occlusal angles. (Fig. 194.)

Any unnecessary surplus should be cut away from time to time as the burnishing progresses, and the adaptation may be facilitated by annealing occasionally. Annealing is accomplished best in the electric furnace. When the adaptation of the matrix has been completed, the porcelain then should be applied.

Fig. 195.

Jacket Crown Restorations Without Shoulder.

Jacket crown restorations may be made successfully without a shoulder by following the technic suggested by Dr. A. L. LeGro. In this procedure the supporting tooth is prepared in accordance with all the requirements indicated previously, except that no shoulder is formed. The unit impression band is trimmed carefully and fitted to pass freely within the gingival border. When fitted, the outline of the gingival border is then marked carefully around the circumference of the impression band. (Fig. 195 A.) The impression in hard compound is then taken. When this is satisfactory a shoulder is built around the impression band with wax, about one millimeter in thickness, and following the gingival outline as marked. (Fig. 195 B.) The amalgam root cast is then made. When the cast has been separated a shoulder, following the gingival curvature, presents. (Fig. 195 C.)

A study of this illustration in comparison with Fig. 185 B discloses the fact that in the former the shoulder in the amalgam cast is entirely within

the periphery of the tooth, whereas in the latter (Fig. 195 C), the shoulder is entirely external to the periphery, the dotted lines indicating the shape of the natural root.

In the subsequent procedure the jacket crown is constructed upon the amalgam cast exactly as though it represented a shoulder crown preparation. Thus the finished crown will present with its external circumferential surface flush with the periphery of the amalgam cast, whereas the true periphery of the natural root is represented by the inner circumferential margin of the jacket crown. If placed on the natural root, the shoulder would impinge upon the gum tissues. This gingival shoulder therefore must be reduced to a thin edge and should be rounded in imitation of the natural enamel. To accomplish this without fracturing the porcelain, the jacket crown is placed on the amalgam cast, and the porcelain and amalgam ground away coincidently, using fine stones kept wet. This ground surface of the porcelain is polished highly with fine disks lubricated with vaseline. The rounded margin thus produced fits under and supports the gingival gum tissues.

This method of procedure makes the preparation of a shoulder on the supporting tooth unnecessary; insures the same accuracy of adaptation; and affords a rounded edge at the line of junction between crown and root which more nearly simulates the normal condition.

This type of jacket crown is especially applicable in the restoration of teeth in the mouths of young patients, where the pulps are large, and the cutting of a shoulder might cause an exposure, or too close an approach to the pulp. But whether in the young or the old a particularly close joint between the crown and the root is essential, in order to minimize the danger of irritation to and consequent recession of the gingiva. The surface of the root therefore should be planed and polished smooth, just as scrupulously as is done by the periodontist in treatment of diseased conditions. In this instance it is for prevention rather than cure.

Porcelain Compounds.

In the manipulation of porcelain compounds, one should be not only a master of the colors, but also of the compounds with which he works. And, to be a master of the compounds, he must know their composition, their physical properties and characteristics, and be familiar with the most advanced methods of manipulation.

Composition. Porcelain compounds are supplied in powder form and are known as "bodies," "enamels" and "gum enamels." They are

composed of silica, feldspar, kaolin and a suitable flux, and are colored or tinted with metallic exodies.

Silica. Silica is the dioxid of silicon, a very refractory and practically infusible substance found in the form of agate and flint. It is the base of all true porcelain "bodies" and imparts structural strength to them.

Feldspar. Feldspar is a double silicate of aluminum and potassium. This material is somewhat less refractory than silica, and is incorporated for the purpose of imparting stability to and increasing the translucency of the compound.

Kaolin. Kaolin is the hydrated silicate of aluminum. This is a very fine grade of clay, and is a most essential ingredient, being incorporated as a binder, and for the purpose of imparting stability of form by holding the particles together, and thus facilitating the molding and carving of the mass into the lesired shape.

Flux. The flux is composed usually of carbonates of the alkaline metals, sodium and potassium, though in some classes of compounds the oxid of lead is used.

The quantity and nature of the flux, and the manner of its incorporation, determines the fusibility of the former refractory ingredients, and the tensile strength, or resistance to fracture, of the mass when all are fused together.

Coloring Material. The coloring material used for the purpose of imparting the required variations of shade must be more or less high fusing in character, in order that the color or tint may not be dissipated or burned out in the fusion of the compound.

While the coloring material itself practically has no influence upon the fusibility of the compound, the color imparted is affected materially by the degree of heat required. For this reason, metals, or metallic oxids, are used for this purpose, in which the basal shades imparted approximately are as follows:

Yellow ....Titanium
Brown ....Iron
Blue ....Cobalt
Gray ....Platinum
Pink (gum enamel).........Silver and tin in combination with gold (purple of cassius).

The colors and tints characteristic of the different porcelain compounds are produced by the use of these various coloring materials in varying proportions, but the exact formulæ and methods of procedure are of special interest to manufacturers only, and usually are carefully guarded by them.

High and Low Fusing Compounds.

Porcelain compounds may be classified into two distinct grades, high and low fusing, with the line of common distinction between them based approximately upon the fusing point of pure gold.

Comparative Advantages. An analysis of the comparative advantages of the two classes of body demands some limited familiarity with the composition of these compounds, and with the characteristics of their respective ingredients.

Silica, being the most refractory and infusible substance, it might be supposed that a body capable of being fused at a lower temperature than another necessarily would contain less of this ingredient and more feldspar and kaolin in proportion.

Such an assumption would be correct if the flux played a less conspicuous part in the reduction, but the same relative formula of the three basal ingredients may be used, and yet the fusing point of the resulting compound be regulated by the proportions of the flux subsequently added to this formula.

But as a body must possess sufficient inherent integrity and stability to offer a high degree of resistance to stress, and must possess translucency, an adequate proportion of these three basal ingredients seems essentially necessary since each has its place and purpose in the compound.

This being apparent, if the fusing point is regulated or controlled by the proportion of flux, and if it is conceded that the latter does not impart to the compound the highest degree of strength, it is evident that, when a sufficient proportion of flux to reduce the fusing point of these refractory materials below a certain point is incorporated, the maximum degree of strength is not imparted to, nor obtained in, the product.

It, therefore, seems evident that when a maximum degree of strength is to be obtained, such as is required in the construction of crown and bridgework, where the finished product is to assume the full stress of mastication, the compound which will serve the purpose best must possess the integrity and stability imparted by the three basal ingredients to a degree not destroyed entirely by the incorporation of too great a proportion of flux.

Shrinkage. All porcelain compounds shrink in fusing, in proportion to the degree of their fineness of texture, and the quantity and nature of the flux used; and the degree of shrinkage adds to the difficulties incident to their manipulation. It is estimated that the high-fusing compounds shrink one-sixth of their bulk, while the low-fusing compounds shrink up to twenty-five per cent.

All of the compounds are translucent in proportion to the degree of fineness to which they are pulverized before fusing. The lower fusing bodies are reduced to a much finer texture in their preparation and hence they possess a greater density of structure.

This increased density, however, is due to the more homogeneous coalescence of the particles, as a result of the more thorough admixture of the flux, and is gained at the expense of translucency and stability, since the flux, beyond a certain proportion, does not add integrity to the mass, but, on the contrary, increases the shrinkage, friability and tendency to globulate in fusing.

A summary of the objections to the use of low fusing bodies thus consists in the degree of shrinkage; the diminished strength and translucency, and the lack of stability of form and color possessed by them.

These features cause their manipulation with accuracy and certainty to be more difficult, because of the necessity for discontinuing the heat the moment the fusing point is reached. This is imperative in order to avoid a dissipation of the color, and a loss of the desired form, as a result of their tendency to globulate immediately, beyond the point of fusion.

For these reasons, the use of the low fusing, or so called enamel bodies, or those which contain a large enough proportion of flux to reduce their fusing point below that of pure gold, cannot be considered reliable for this work.

Gum Enamel Bodies. The compounds designated as gum enamel bodies contain a larger proportion of flux than basal bodies, and, consequently, fuse at a lower degree of heat, and possess less strength. Hence, when their use is indicated for the purpose of producing an artificial restoration of gum color, the major portion of the contour of the piece should be made of basal body, and the gum enamel applied subsequently where necessary, and only for the purpose of imparting the color.

Previous to the application of the gum enamel, the basal body to be covered by it should be fused until it presents a fairly smooth and well vitrified surface. This is necessary because it is not to be refused, and

the maximum degree of strength will not obtain until its particles are well coalesced, and all shrinkage has taken place.

Requirements for Crown and Bridgework.

A compound possessing qualities adaptable to the maximum requirements for crown and bridge-work must belong to the high-fusing variety, and should be prepared in one grade of a sufficient variety of colors, and pulverized only to a degree of fineness which will admit of being carved nicely. This latter feature is essential, because the shrinkage is increased and the fusing point decreased, in any given compound, in proportion to the degree of fineness in which it is prepared.

The following porcelain compounds are made especially for, and are supplied in a variety of colors quite adequate to the requirements of this work:

S. S. White high-fusing	2560 degrees F.
Justi	2500 degrees F.
S. S. White crown and bridge	2300 degrees F.

In building jacket crowns, one grade of body should be used throughout, and greater strength and better color are obtained from the use of the higher fusing bodies. A lower fusing body is useful mainly for making any final touches such as increasing contact points, producing sharp angles and in making any addition to or changes of contour or color which may become necessary.

Use and Manipulation of Porcelain Compounds.

Selection of Color. The colors selected should match the shade of the natural teeth as closely as possible. The shade-guide, which accompanies the porcelain compounds, is not always reliable. Hence, it is safer to make a shade button from the contents of each jar of compound before using it.

If the exact color cannot be matched, and some variation becomes necessary, a shade slightly darker should be used, in preference to one which is lighter, owing to the possibility of bleaching in fusing. In this connection it should be remembered that the true color of porcelain compounds will be exhibited only when they are fused to the exact point of complete vitrification, and that they will become lighter in shade as they are carried beyond, or above, this point.

Mixing Body. An adequate quantity of the body selected should be placed upon a clean glass, porcelain, or agate mixing slab, and, using distilled water or alcohol, mixed thoroughly with a suitable spatula, until it assumes a thick, plastic consistency. As it is mixed, the water or alcohol may be added in the most convenient manner by means of a "dropper."

Sufficient water or alcohol to insure the desired consistency and thorough mixing are quite essential. Any surplus of body is not wasted, because what remains unused may be placed in its proper container and used at another time.

Alcohol is used because of its rapid evaporation, but this is more often an objection than an advantage. Clean, pure water is preferable. It should be distilled, however, because the presence of the lime salts, or organic matter, is objectionable.

The addition of a small quantity of gum tragacanth is recommended as furnishing a means of increasing the cohesion of the mix and thus facilitating the carving and contouring. Its use is objectionable, however, because it acts as a flux. The manufacturers of porcelain compounds usually incorporate a small proportion of gum tragacanth, or of starch, for this special purpose.

Applying and Building. In the manipulation of porcelain compounds, it must be remembered that shrinkage plays quite an important part, and must be taken into consideration at all times.

One Grade of Body. In the use of one grade of body throughout the construction of the case, the desired shape and contour for the finished crown should obtain for the first, or primary, bake. It is seldom possible, however, and rarely ever expedient to complete the case in one bake because of the shrinkage.

This feature of shrinkage necessitates two, and sometimes even three bakes, but by forming the desired contour, even to the requirements of occlusion and approximal contact for the primary bake, the second application of body is made for the purpose of restoring the original form to the extent to which it has been changed by shrinkage.

The matrix must be perfectly clean before applying the body. This is to be insured by passing it over a flame until a red heat obtains. It then should be placed in position on the amalgam cast, and a small piece of heavy paper previously cut to the required size, wrapped around the cast and matrix in such manner as to form a wall (or matrix) for the purpose of sustaining the porcelain in contact with the platinum matrix, of aiding in building the porcelain to the required proportions, and of

facilitating packing it firmly. Any kind of paper, except one having a glazed surface, may be used. When the paper matrix has been adjusted it may be held in place by tying it with a ligature.

A small quantity of body, mixed to the proper consistency, should be picked up with the point of a suitable instrument and first placed against and packed around the shoulder. This may be facilitated by gently tapping the amalgam cast, or by drawing a coarsely serrated instrument across it, and this procedure should be continued until the paper matrix is completely filled and the body is packed thoroughly.

A convenient carving instrument designed for universal use in this work is illustrated in Fig. 196.

As a means of insuring a high degree of strength in the compound when fused, and of overcoming porosity in fusing, by insuring a close and compact coalescence of the particles, the feature of condensation is imperative throughout the entire building up of the crown.

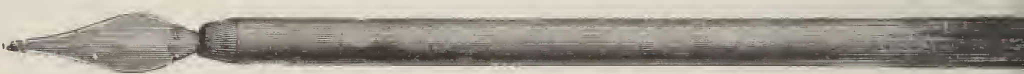


Fig. 196.

As the building up progresses, and as each additional application of body is carried to place, and the contour formed, the procedure may be facilitated by absorbing the excess moisture as it is brought to the surface. A clean piece of linen, or cotton cloth, or blotting or bibulous paper may be used for this purpose.

The latter part of the procedure may be facilitated by mixing the body to a thicker consistency.

When the required form has been obtained, any remaining excess moisture should be evaporated by passing it over a flame, or by waiting until the mass is sufficiently dry to retain its form and to admit of being carved nicely. It should be allowed to remain moist enough, however, to be carved and trimmed without flaking or crumbling, and in the event of its becoming too dry to admit of fine carving, it may be moistened again by touching it with a wet brush.

Variations in Shading. Variations in shading may be obtained easily by selecting the desired colors and mixing them separately, and on separate mixing slabs. The colors for the foundation, or gingival portion of the crown should be applied and built up to the desired point. after which the incisal, or occlusal color may be added without allowing the first to become completely dry.

Opportunity for blending them as desired is afforded thus and very artistic results are possible, particularly in those cases where the base is to be yellow or brown, and the incisal or occlusal end blue or gray, in any of their variations.

Carving and Contouring. When the moisture has been evaporated sufficiently, the paper matrix should be removed and the crown contoured and carved as desired. If not too dry, the procedure incident to contour-

Fig. 197.

ing and carving is quite simple, but the artistic results will depend much upon a knowledge of tooth form.

This knowledge may be acquired easily by a close study of natural teeth, and a good plaster cast of a full typical arch will assist by serving as a guide in the execution of this work.

The requirements of occlusion and of approximal contact may be satisfied by trying the crown upon the casts frequently during the process of carving, and in order to prevent any flaking, or change of form, it may be moistened slightly with a wet brush previous to such trials.

In carving and contouring, the porcelain must not overlap the shoulder at any point. And, previous to placing the crown in the furnace, all particles of body which may have become deposited upon the inside of the matrix should be removed carefully with a clean, dry brush to prevent it from becoming attached in fusing.

The brushes used in this work should be of good quality such as are used in water-color painting, and three useful sizes and shapes are illustrated in Fig. 197. The one of largest size always should be kept dry

and used only for smoothing up the surfaces, while the one of medium size should be used for the purpose of remoistening the body when necessary, and the smaller one only for deepening the finer lines in carving.

Shrinkage. In contouring and carving a surplus is demanded by the shrinkage, which is estimated at one-sixth in all high-fusing compounds, but the exact shrinkage may be ascertained with accuracy only by a familiarity with the compound used.

It is impossible to control or overcome shrinkage, and, hence, an allowance for shrinkage must always be made in building porcelain crowns. The foundation proportions, therefore, must be approximately one-sixth larger in every direction than the size desired and required in the finished crown.

All porcelain compounds assume globular form if overfused, or when fused to a degree beyond that required to produce a vitreous surface. They begin to fuse on the surface and at the point where they are thinnest, and, hence, shrinkage begins at this point; but the shrinkage is in the direction of a common center, and the common center is at the point where the greatest thickness obtains.

The thinnest point in a jacket crown is at the shoulder, and the platinum matrix, being a good conductor of heat, fusion and shrinkage begin at this point. Therefore, when fusion begins, and as it progresses, the porcelain will draw away from the platinum matrix at the shoulder, and shrink toward the center.

In order to prevent any distortion of the matrix which might be caused by the shrinkage at this point, and, in order to aid, rather than to retard shrinkage, it is always best to destroy any actual contact between porcelain and matrix at the shoulder before fusing. This precaution should be taken always and may be accomplished best by first slightly moistening the porcelain around the entire circumference at the shoulder, and inserting a very thin blade between it and the matrix at this point before fusing.

When the carving has been completed, and when this and all other requirements have been met, the crown is then ready for the primary bake.

Primary Bake. The crown should be detached from the amalgam cast carefully, and then placed in the furnace properly and baked until a vitrified surface presents, but complete vitrification should not be permitted at this time.

Fusing to the point of the beginning of vitrification in the primary bake is necessary because of the desirability of securing a maximum degree of shrinkage at this time.

Final Bake. Usually the crown may be completed in two bakes. For the final bake, the body should be mixed thoroughly to a thin consistency, and first worked well down into every crevice and fissure caused by the shrinkage. Necessary restoration should be made until the desired contour is again obtained at all points. The crown then should be placed in the furnace and fused to the required degree of vitrification for the finished work.

If, after this bake, the crown presents an irregular or broken surface, or if further additions are necessary, the same, or a lower-fusing body may be used and the crown fused again, though, if the proper precautions are taken, this seldom will be necessary.

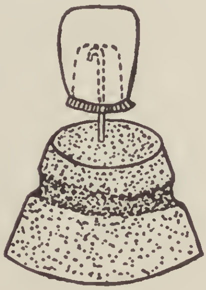


Fig. 198.

Precautions Incident to Fusing. No portion of this work is of more importance than the baking or fusing of the body, because the strength of the porcelain and its true color are dependent upon its being fused properly.

Supporting Crown in Furnace. When the crown is ready for the furnace, it must be adjusted to a suitable support which will allow it to rest firmly and evenly, and which will sustain it in a vertical position while in the furnace. It may be supported thus by means of a piece of platinum wire of suitable length, mounted in a base made of fireclay (Fig. 198), or it may be placed in a bed of coarse silex.

Placing Crown in Furnace. In placing the crown in the furnace, it should be observed that it does not come in contact with the walls of the muffle, and it should be held in a vertical position in order to preclude any change of form which the influence of gravity might cause, if even slightly overfused. A design of pliers useful for this purpose has been illustrated previously in Fig. 26.

Heating Furnace. As a matter of expediency, the heating of the furnace should begin at some time during the building up of the crown, so that the muffle will be warm when the crown is ready for the baking.

When this precaution has been taken, the support carrying the crown should be placed near the opening of the heated muffle and allowed to remain for a few moments, in order to become thoroughly dry, before it is placed inside of the furnace. This will preclude blistering the surface of the body, or the flaking of particles from the crown, as a result of the expansion of the remaining moisture, which would be induced by too rapid heating.

In placing the crown in the furnace, it should be carried to a position as nearly in the center of the muffle as possible, or to that point where there are the greatest number of heat units. For the reason that the heat area varies in intensity to a considerable extent, it is seldom advisable, in the smaller muffles which have an opening in one end only, to bake more than one, or possibly, two crowns at a time; and, if each is to be baked uniformly, they must be placed crosswise in the center of the muffle, as the temperature increases toward the back and decreases toward the opening.

Fusing. In fusing porcelain bodies, the physical process involved constitutes changing the powdered granular mass into a vitreous substance, which then is homogeneous in proportion to the thorough admixture of the flux, or the degree of complete coalescence of all the particles.

Hence, unless a pyrometer furnace is used, the proper fusing of these compounds is largely a matter of experience. In very low fusing bodies, the proper and desired degree of vitrification may be ascertained easily and definitely by observing this physical change as it is produced in the application of heat. This also is true of higher fusing bodies to some extent, but the greater degree of heat required, and the consequent incandescence within the furnace, cause it to be more difficult.

The eye may be trained to a degree of familiarity with the physical changes which will enable the experienced craftsman to distinguish more or less easily the disappearance of the rough or granular surface, and the appearance of the smooth, glassy, or vitreous surface, even in the somewhat trying glare of incandescent heat. With the majority of persons this may be done without greatly endangering or impairing the sight because it is not necessary to bring the eyes close enough to the furnace to be affected seriously by the heat, but smoked or colored glasses may be found useful for those who may fear impairment of sight.

During the fusing of the body, the furnace may be opened occasionally,

and without danger to the porcelain, because the volume of heat units is too great to admit of the ingress of cold air.

While any one desiring to do porcelain work in the most accurate and successful manner without a pyrometer furnace should cultivate this degree of familiarity with the characteristic appearance of the body in the various stages of vitrification, skill may be acquired only through experience.

When the crown is placed properly in a furnace having no pyrometer, the heat should be increased gradually until a bright red color is produced. This may be done by degrees without observing the crown itself, but from this point on the fusing should be watched closely so as to observe when the rough and granular surface becomes smooth and vitreous, which, to the experienced eye, is indicated by the degree of incandescence reached, and as soon as a glassy appearance has spread over the entire surface of the porcelain, the heat should be discontinued immediately.

Tests. Many tests for determining the exact heat required to fuse the various bodies properly have been suggested, but none is accurate or reliable. The use of pure gold will serve as a guide to the beginner, and as an aid to the experienced. A pellet of foil, or a small piece of plate placed beside the crown in the furnace will indicate when a temperature approximating 2016 degrees F. has been reached, by melting and assuming globular form.

In fusing compounds, which fuse higher than pure gold, the heat required beyond this point is gaged by time, and some experimentation is required to ascertain the exact number of minutes and seconds beyond this point for the particular compound used. Pure gold, therefore, is helpful only to this extent.

Pyrometer Furnaces. Any element of uncertainty, doubt, or danger, is overcome entirely, and certainty and accuracy in all cases are made possible and insured by the use of the electric furnace with a pyrometer.

Its use affords results which are true, scientific and accurate, and such results are desirable and necessary in porcelain work. If high fusing compounds are used, and if the best results obtainable are desired, the electric furnace must be used, and the pyrometer furnace should be used, to the exclusion of all other methods of heat production, and of accuracy in fusing.

Cooling and Annealing. When the baking has been completed and the generation of heat has been discontinued, the furnace should be allowed to cool slowly. The crown never should be removed from the muffle

until cool enough to be held in the hand. This eliminates any danger of fracture, or brittleness, and so *anneals* the porcelain as to insure a maximum of strength in the finished product.

Final Requirements. When the crown has been removed from the furnace after the last baking, the surplus matrix should be trimmed away even with the porcelain at the shoulder. The crown then should be tried to place on its supporting root in the mouth. If any changes of

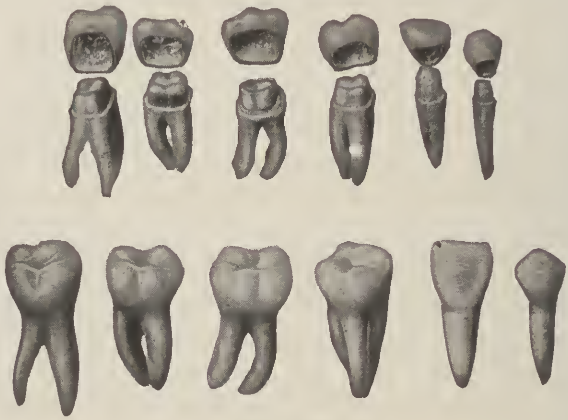


Fig. 199.

form are required they should be made at this time, and before the entire matrix is removed.

If additions to the contact points, to the angles, or in length are demanded, requiring another baking, such additions should be made and the crown baked again.

If any desired change in form or outlines should necessitate grinding, the grinding should be done with clean carborundum stones of fine grit. Surfaces which have been ground should be polished highly with fine disks after grinding, and if any extensive grinding is demanded, the crown should be baked again. This is necessary, because a surface once ground never can be glazed again by polishing.

Porosity. Porosity after baking is an unnecessary and discouraging calamity. It is due to one or the other of three different causes: To imperfect spatulation in mixing; to imperfect condensation in packing the body in forming the crown, or to overfusing. Imperfect spatulation and imperfect condensation are inexcusable, and overfusing must be avoided.

Overfusing. In the fusing of porcelain compounds, overfusing must be avoided. Strength and form and color in any of these products may be obtained only when the compound is fused properly, and never when it is overfused.

Staining and Coloring. The characteristics of the remaining natural teeth may be reproduced, and grooves, pits and sulci may be tinted as desired by the use of mineral stains which are prepared for the purpose.

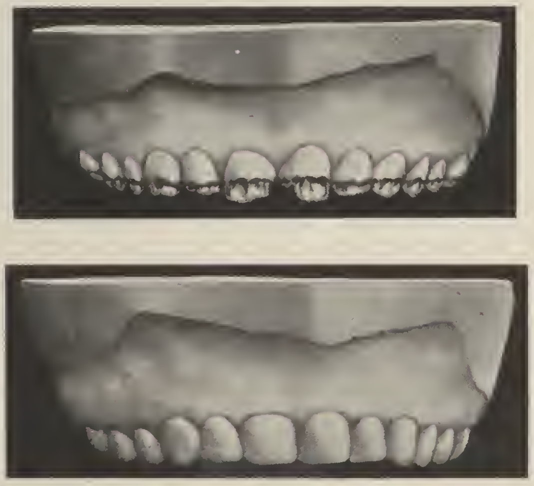


FIG. 200.

As these colors fuse at a lower heat than the porcelain body, however, this work is done to the best advantage after the crown has been completed otherwise. When they are used for the reproduction of erosions, etc., on the labial or buccal surfaces, the desired inequalities first should be ground and formed with a small carborundum stone in the engine, and this outline tinted properly with the stains, or colors, and the crown then placed in the furnace again until the colors become vitreous.

Grooves, pits, and sulci may be stained without grinding, and highly artistic results are possible.

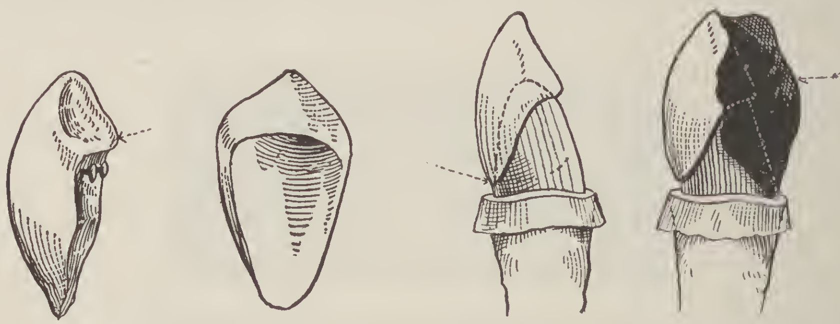
When all requirements of a finished product obtain satisfactorily, the crown then should be dipped in alcohol, or water, and the matrix removed.

Mounting. In mounting porcelain jacket crowns, a cement, approximating the color of the crown, should be used, and care should be exercised to avoid fracturing or chipping the edge in forcing it to place.

After mounting, the joint between crown and supporting root always

should be finished down until smooth, using fine, narrow finishing strips for the purpose.

Some idea of the possibilties of porcelain jacket crown restorations may be obtained from Fig. 199, and the restoration of the six upper anterior teeth in a case of typical Hutchinson teeth is illustrated in sequence in Fig. 200.



A B C D

Fig. 201.

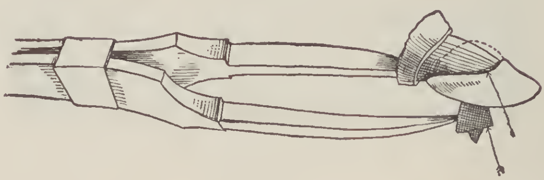


Fig. 202.

Use of Porcelain Teeth as Veneers.

As a means of obtaining form, type and color with accuracy and certainty, vulcanite teeth may be used instead of building and carving the crown entirely of porcelain. In the absence of suitable porcelain bodies, and in the absence of skill in selecting colors, and in reproducing form and type, this method of veneering the matrix, as suggested by Dr. E. B. Spaulding, is productive of good results.

Porcelain teeth designed for vulcanite work are used, because of the advantage afforded by the lingual shoulder. (Fig. 201 A.) In their use for this purpose, a tooth which meets the requirements of form, type and color should be selected. The pins and the entire lingual surface should be ground away to the shoulder, until only a thin veneer presents. (Fig. 201 B.)

This procedure may be accomplished easily with small mounted stones of appropriate size and shape, kept wet while grinding. The grinding should be continued until the veneer fits over the matrix, as indicated in Fig. 201 C.

When the desired adaptation has been obtained, the correct relationship between the veneer and the matrix should be sustained with temporary stopping (Fig. 201 D) and the two then removed from the cast. Then they should be adjusted to tweezers, or pliers, which will retain this relationship securely, while packing and carving the body to meet the requirements of form and contour. Soldering pliers having a locking band are useful. A small piece of unvulcanized rubber should be placed between the veneer and one of the beaks as a means of holding the veneer securely, and to prevent it from slipping. The other beak should be carefully inserted inside of the matrix. (Fig. 202.)

The two thus held securely, the temporary stopping should be warmed and removed, and the body applied, formed and carved as the requirements may demand. When the carving has been completed the body should be allowed to become thoroughly dry, and the crown then removed from the pliers carefully, adjusted to position in the furnace properly, and fused. Two bakings usually will complete the crown.

Porcelain in the Construction of Dowel Crowns.

Porcelain may be applied successfully to the construction of dowel crowns also.

Restorations of this type are made with a platinum coping and a flat-back facing soldered to the coping. The body of the crown then is completed with porcelain.

Indications. Crowns built in this manner are indicated wherever the esthetic requirements demand the use of porcelain, and wherever the dowel-crown type of construction, for any reason, may be preferable to the jacket crown. Porcelain dowel crowns, however, are not as strong as all-porcelain jacket crowns, and they possess but one advantage over the jacket crown.

It is difficult, therefore, to conceive of any application in which the use of this type of crown might be preferable to a full all-porcelain restoration as a single unit. And, yet, when such crowns are built properly, they possess esthetic features combined with a degree of strength, quite adequate to the requirements of single unit restorations, and, being built upon a platinum coping, they also afford an esthetic means of attachment

for bridgework of any kind. This latter feature constitutes the one advantage.

Requirements. To obtain such results with a maximum degree of strength, however, three essential requirements must be observed:

First: The coping must be made strong enough to afford adequate strength in the attachment of the crown to its supporting root, and to support and protect the porcelain forming the body of the crown.

Second: The facing must be adapted properly and attached securely to the coping.

Third: The application of porcelain must be made only with a view to and for the purpose of meeting the requirements of form and esthetics.

Coping. In order that adequate strength may obtain in the coping, a gage of platinum sufficiently thick to retain its shape and form must be used for all parts except the dowel. For this purpose the alloy of iridium and platinum is used because of the infusibility of platinum and of the additional strength imparted to it by the incorporation of a small proportion of iridium.

Soldering. In soldering, perfect contact between all joints must obtain and a solder which will withstand the subsequent baking of the crown must be used. If absolute contact obtains, pure gold may be used as a solder, provided it is fused thoroughly, and until it practically becomes alloyed with the platinum. But if the greatest degree of strength is to be obtained, platinum solder, 25 per cent, should be used, and its use is absolutely necessary wherever contact does not exist.

Should absolute contact not exist, and pure gold be used as a solder, a union which will withstand the heat of the blowpipe, or of the furnace, will not be secured.

Oxyhydrogen Blowpipe. The oxyhydrogen blowpipe is necessary in the use of platinum solder, and also may be used to good advantage with pure gold.

Root Preparation. The requirements of root preparation are the same as indicated previously for any of the various types of dowel crowns.

The coping may be made either by the direct or the indirect method, and the details of procedure for each method are the same as indicated previously for dowel crowns.

Adaptation is the basic requirement in the construction of copings for any type of crown restoration. Hence, when this requirement obtains, the particular method by which adaptation is secured is of but little im-

portance. A choice of methods, therefore, is a question largely of personal preference.

Indirect Method. While platinum is not quite so soft and malleable as pure gold, still it may be swaged, or burnished, easily. Therefore, the indirect method may be used successfully. But in making a platinum coping by the indirect method, a thickness of plate as heavy as can be swaged, or burnished successfully, must be used, because it is not reenforced subsequently to any appreciable extent.

In order that adequate strength may exist in the coping itself, therefore, when the indirect method is followed, pure platinum, 30 gage,

B A C

Fig. 203.

should be used, and never thinner than 32 gage. Platinum of this thickness may be swaged or burnished successfully and easily, thus insuring accuracy of adaptation; and it is heavy enough also to provide strength.

While a full band, a partial band, or no band at all may be used, as the requirements of the case may indicate, the indirect method is applicable more particularly to restorations where a partial band only is to be used.

Direct Method. The direct method is indicated especially in cases where the requirements demand a full band, and a maximum of strength in the coping.

Full Bands. Where a full band is to be used, it should be made of platinum (28 gage) and the edges should be overlapped. This precaution should be taken as a means of securing additional strength, and of precluding the subsequent opening of the joint from the exceedingly high degree of heat necessary to fuse the porcelain. The exact length of the measurement of the root should be designated on the surface of the platinum plate from which the band is to be cut. A band of proper width then should be cut, with an allowance of about one millimeter surplus.

(Fig. 203 A.) Each end then should be slightly beveled on one side and the band annealed and bent into circular form. The surplus end, designated by the measurement marking, should overlap the other end until the marking approximates evenly with this edge. (Fig. 203 B.)

The surplus overlapping end must be placed on the outside to prevent diminishing the size of the band, and the relationship may be sustained by pinching the ends together closely with flat-nose pliers. This produces a sharp angle on each side of the joint and affords a flat surface contact. (Fig. 203 C.) This procedure usually will overcome any change in the relationship of the surfaces which might result from expansion when heated.

The joint then should be soldered with 25 per cent platinum solder, or with pure gold, in the manner indicated. The band now should be trimmed to follow the gingival curvature, the edge nicely rounded and then fitted to the root. It afterward should be trimmed down until as narrow as possible, in accordance with the requirements mentioned.

Floor. A piece of platinum about 32 gage now should be cut somewhat larger than the diameter of the band. The band should be placed in position on it, and the relationship first simply tacked with a small bit of solder. This primary attachment secures the relationship and anneals the floor, so that it then may be burnished easily into close and direct contact with the edge of the band, without danger of changing the shape of the latter.

The soldering now may be completed. If pure gold is used, it must be noted carefully that perfect contact exists at all points. After soldering, the surplus may be trimmed away and finished down until flush with the edge of the band.

Dowel. The dowel should be made of iridio-platinum wire of a size proportionate with the size of the root and the requirements of the crown. It then should be fitted to the canal in the manner outlined previously.

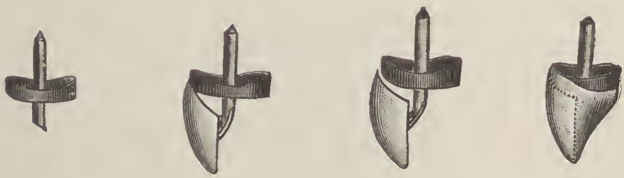
The coping now should be adjusted to position on the root, and the floor perforated at the proper point. The perforation then should be enlarged to the diameter of the dowel by forcing the dowel to place through it.

This insures a perfect contact between floor and dowel, which is essential to the strength of the joint and to the facility with which the soldering may be accomplished.

The relationship now should be sustained temporarily with hard wax, or temporary stopping, and the parts then removed, invested, and soldered.

Impression and Bite. When the coping has been completed, finished and adjusted to its proper position on the root, the bite then should be taken in wax and the impression in plaster.

It should be observed that the coping rests firmly and accurately in place in the impression. The interior of the band and the exposed end of the dowel then should be painted with melted wax to facilitate its removal from, and to admit of its accurate replacement upon, the cast.



A B C D

Fig. 204

This precaution is important, because of the necessity for trying the crown to place on the cast frequently during construction, and particularly in cases requiring restoration of contact and occlusion.

Selection of Porcelain Facing. A flat-back porcelain facing, having platinum pins, should be selected carefully and should meet all requirements of color, size and type. As the color is likely to be bleached slightly, instead of becoming darker, if some variation is necessary, it invariably should be darker rather than lighter. Porcelain teeth made of high-fusing porcelain retain their color and rarely change to any appreciable extent.

But it is always necessary to use a body, the fusing point of which will not affect the color of the facing. As an example, the use of high-fusing body in combination with English facings (Ash and Sons) will destroy the color entirely.

In grinding the facing, the edge of the coping should be nicely rounded previously with disks. (Fig. 204 A.) The facing then should be ground to overlap the labial, or buccal, surface of the coping, in order to prevent undue prominence at this point. (Fig. 204 B.)

This overlapping is necessary as a means of bringing the gingival edge of the facing into close proximity with the gingival tissue. It is necessary also for the purpose of affording a mechanical retention to the porcelain with which this portion of the band should be covered.

If the band is not covered entirely upon this surface, it always will show through the thin, transparent, gingival tissue and cause a dark blue appearance at this point.

This discoloration is a decidedly undesirable feature, and since there is no physical union between porcelain and platinum, the overlapping of the facing affords a secure mechanical retention for porcelain, sufficient to cover this portion of the band, and to present a smooth, flush joint in the finished crown.

Wherever it is desirable to retain porcelain in contact with a surface of platinum, some means of mechanical retention is always necessary.

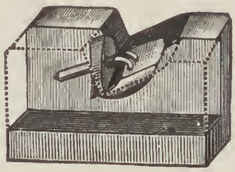
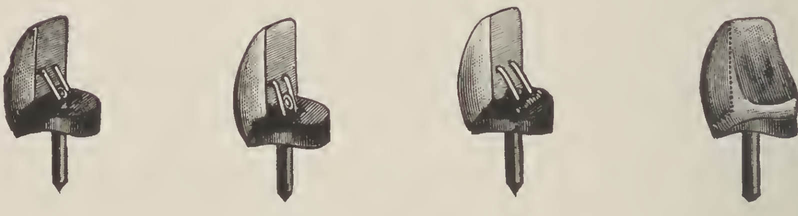


FIG. 205.



A B C D

FIG. 206.

Increased mechanical retention may be obtained by allowing a very slight space to exist between facing and coping. (Fig. 204 C.)

When the facing has been adapted properly, its relationship to the coping should be sustained with adhesive wax, and coping and facing then detached from the cast and invested. The finished crown, showing the possibilities of contour, strength and esthetics, is illustrated in Fig. 204 D.

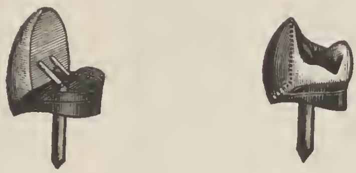
Investment. In investing, only enough investment to sustain the relationship and to afford sufficient strength should be used, and when the investment compound has crystallized, all surplus should be trimmed away until the entire lingual surface of the facing is exposed freely. (Fig. 205.)

A free exposure is necessary as a means of facilitating soldering, and it may obtain without danger of fracturing the facing, if the case is heated adequately before attempting to solder.

Soldering Facing. Before heating the case, the pins should be bent down toward the facing until their ends may be brought into absolute contact either with the dowel or with the coping. This bending may be done by holding the facing firmly in place with a blunt instrument, and then applying sufficient pressure to the extreme ends of the pins to bend them into the relationship desired. It is desirable always to bend the pins down close to the facing and thus afford more space for the porcelain.

Anterior Crowns. In anterior crowns, the pins should be bent down close to the facing until their ends are brought into direct contact with the

Fig. 207.



A

Fig. 208.

surplus end of the dowel at a point as close to the floor of the coping as possible. (Fig. 206 A), or, until they are in direct contact with the floor itself. (Fig. 206 B.)

This feature of construction is important because it affords the same degree of strength in the attachment of the facing to the coping and adds to the strength of the finished crown. Otherwise the pins would divide the porcelain through the center and interfere with the proper and desired contour of the lingual surface.

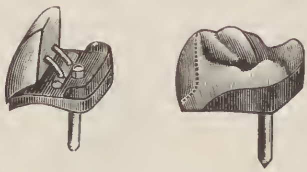
In cases where the ends of the pins will not reach to the floor, or to the dowel, the space should be filled in with platinum plate, or wire, until contact is secured as illustrated in Fig. 206 C. The finished crown, showing the possibilities of contour, strength and esthetics is illustrated in Fig. 206 D.

Leaving Pins Exposed. Another variation of construction consists in bending the pins down until their ends come in contact with the floor, and then filling in between them with platinum solder, and subsequently making no effort to cover them with porcelain. (Fig. 207.)

Bicuspid Crowns. Since there is no physical union between the porcelain and the platinum, in the construction of bicuspid crowns it is not only desirable to make as much accommodation for the porcelain which is to form the entire lingual contour of the crown as possible, but

it also is necessary to provide some means for mechanically retaining and supporting it.

Adequate mechanical support to the porcelain may be obtained best and most easily by soldering a narrow strip of platinum plate, about one millimeter in width, to the floor of the coping on a line even with the edge of the band. This addition should be fitted before heating the case, and should be attached at the time of soldering the facing. It thus forms a box-like support for the porcelain. (Fig. 208 A.)



A B

Fig. 209.

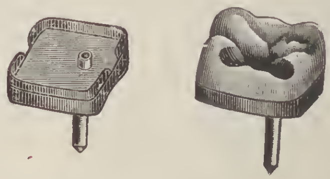


Fig. 210.

This method of construction is applicable to incisor, cuspid and molar crowns, as well as to bicuspid crowns. The finished crown is illustrated in Fig. 208 B.

Reenforced Coping. Inherent strength in the coping itself is a prerequisite in this class of work. Therefore, the increased strength to be obtained by reenforcing the coping in the manner previously suggested as applicable to the construction of dowel crowns, often may be used to advantage.

This increased strength is to be secured by allowing the floor to project slightly beyond the band upon the mesial, distal and lingual surfaces, and then filling in the shoulder so formed with platinum solder (25 per cent) until smooth and flush, as illustrated previously in Fig. 147.

Molar Crowns. In the construction of molar crowns, two methods may be followed. One embraces the use of a facing, as described in the construction of bicuspid crowns, and the other consists of making the coping and building the entire crown of porcelain without the use of a facing.

With Facing. While it is true that the requirements of color are not quite so important in molar restorations, yet the use of a facing often is indicated as a means of obtaining form and color.

When a facing is used, the details of construction are the same as indicated for bicuspid crowns. (Fig. 209 A.) The finished crown is illustrated in Fig. 209 B.

Without Facing. In cases where the requirements of occlusion demand a very short restoration, the use of a facing may be contraindicated, and the best results obtained by making a simple coping and forming the entire crown with porcelain. In such cases the porcelain must be supported by a boxing or housing around the entire circumference, which, together with the finished crown, is illustrated in Fig. 210.

Fig. 211.

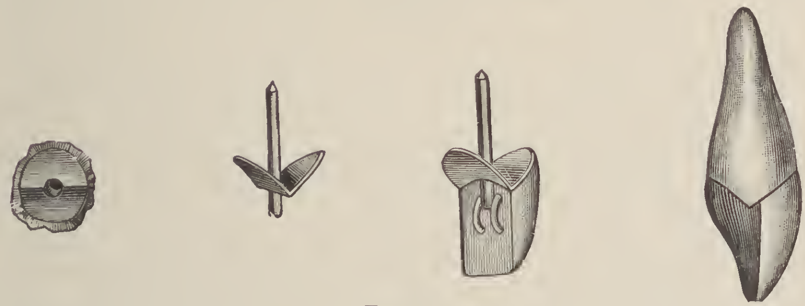


Fig. 212.

Additional mechanical attachment of the porcelain to the coping may be secured by roughening the surface of the platinum with a sharp-pointed instrument, or by soldering small loops made of round platinum wire.

Partial Band. Where only a partial band is required, and where the direct method of construction may be preferable to the indirect method, for any reason, a platinum coping may be made in the manner indicated previously for dowel crowns with partial bands, combined with an observation of the requirements for porcelain work.

The band should be made of 28 gage, and the floor of 32 gage platinum and the structural requirements for porcelain work, together with the completed crown, are illustrated in Fig. 211.

Without Band. In the construction of porcelain dowel crowns without a band, the adaptation of the floor, or basal portion of the coping, may be made successfully either by swaging or burnishing, and pure platinum, about 32 gage, should be used. The structural requirements and the completed crown are illustrated in Fig. 212.

Casting Porcelain. Efforts directed toward casting porcelain have been made and are being made. Success would revolutionize porcelain work, much as casting gold has revolutionized all other restorative and reparative procedures. Hence, the advent of casting porcelain successfully will be welcomed.

Principles and Technics of Fixed Bridgework

CHAPTER XIV.

BRIDGEWORK.

Perhaps nowhere in the human economy is the mystifying ingenuity of the Creator evidenced more wonderfully than in the masticatory mechanism.

And when it embraces a full complement of sound, healthy, normally posed single units, perfectly coordinated, it is not within the realm of human endeavor, nor within the province of art to reproduce, much less to improve upon, the original plan.

In the original plan the loss of any one single unit probably was never anticipated. That this is true, is evidenced in the eruption of the third molars, which, appearing after all other teeth, after the period of adolescence, and after complete development, majestically close and lock the arches.

History teaches, however, that from the beginning of civilization the human family has suffered the loss of teeth, and that efforts toward the replacement of missing teeth were made many years before the Christian era.

While it is probable that the primitive efforts in the replacement of missing teeth were made for the purpose of esthetics alone, it is recognized now that esthetics constitutes but one indication for restoration, and that restoration of function is even of greater importance.

It is recognized now that once this wonderfully coördinated mechanism, the dental arches, is disturbed, it never again will be physiologically perfect; that the loss of even a single unit unlocks the interrelationship of the whole, and that any derangement is followed by impairment of normal functioning activities. And it is recognized further that any impairment of the normal functioning activities of the teeth is followed by a lowering of the tonicity, health and resistance of their investing and environmental tissues.

Therefore, it is evident that when either of the dental arches has been disturbed by the loss of one or more units, the missing units must be replaced in order that normal health may be restored, and in order that normal balance may be maintained.

The replacement of missing teeth, however, is always a problem of serious portent, because it means that the remaining teeth, or the environmental tissues, or both, must bear the burden of assuming the function of the missing unit, or units, in addition to the requirements incident to their own normal activities.

And as the extent of impairment and the degree of additional burden increases in proportion to the number of units lost, and which must be replaced, it will be observed that an intrinsic value should be placed upon each and every single unit in the normal denture.

A recognition and an appreciation of these important considerations always should encourage a conscientious effort to avoid impairment of normal function, and of overburdening of remaining teeth, and, thus, to contribute to health, to comfort, and to longevity by conserving the natural teeth.

The maintenance of normal conditions and the conservation of health, therefore, places a responsibility upon the shoulders of all who are inclined honestly and conscientiously; and this responsibility should encourage an effort to save the natural teeth under all favorable conditions.

And yet, however zealously such effort may be made, until such time as preventive dentistry shall have become a realization, teeth will be lost.

They will be lost as they have been lost, because of neglect, disease or accident, or by virtue of the ravages of time and use, habits and foods, and largely because of failure to recognize and appreciate their value.

When they are lost from any of these causes they must be replaced, and when they are replaced, the replacement must be made in a manner which will cause the least injury to the remaining natural teeth, and which will insure the maximum of efficiency and of permanency in the restoration of function.

The replacement of missing teeth, therefore, is an art. It is an art which occupies an important place in the field of prosthetic dentistry, or prosthodontia.

Prosthetic dentistry, or dental prothesis, defined, means the art of restoring lost dental organs and associated parts with an artificial substitute.

Prosthodontia, defined, means a restoration of the teeth by means of an artificial substitute, or substitutes. The term, prosthodontia, thus

limiting the restoration to the teeth alone is not entirely comprehensive, and, hence, has not been accepted generally.

Previous to the advent of the specialty of crown and bridgework, missing teeth were supplied by means of partial dentures made of gold or silver, and, later, of vulcanite, covering the hard palate, or the underlying tissues, and retained by adhesion only.

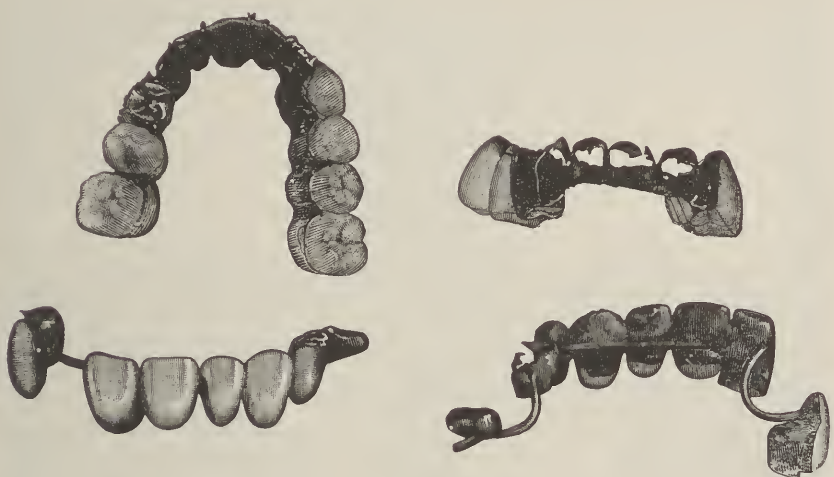


Fig. 213.

The introduction of clasps followed. This means of retention was such an improvement over adhesion alone that the supporting base was made smaller and smaller. It soon was discovered, however, that partial clasp dentures may be injurious to the crowns of supporting natural teeth, and the base itself, irrespective of its size, may be injurious to the health and normal relationship of the gingival tissues around the remaining natural teeth.

Then came a resurrection of the ancient method of supplying missing teeth by attachment to remaining natural teeth, and the introduction of modern fixed bridgework followed. This seemed to offer so many features of advantage over former methods that it soon came into general use, and was applied indiscriminately.

The possible advantages of supplying missing teeth by a fixed attachment to remaining natural teeth, and of avoiding, thus, the wearing of any type of removable structure, which appealed at once to the wearer, were buried soon under an avalanche of indiscriminate and injudicious application, with the result that the requirements of health, hygiene and sanitation were ignored, and failure followed.

The irreparable injury done to sound teeth, together with a failure to observe the requirements of health, hygiene and sanitation, could be expected only to result in failure. And, notwithstanding the myriad of methods and devices which were introduced from time to time, failure was recorded in a large percentage of cases.

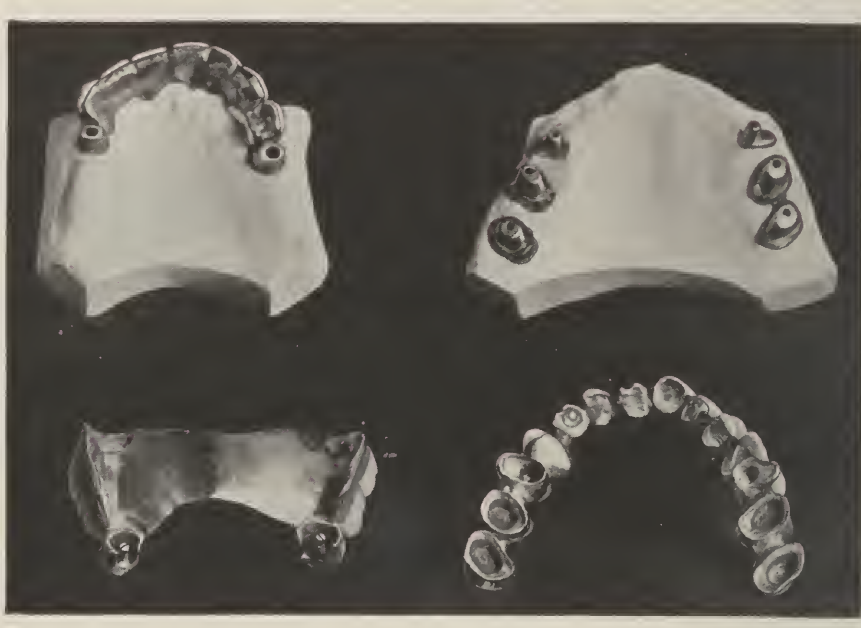


Fig. 214.

As a means of obtaining increased opportunities for an observation of the important requirements of health, hygiene and sanitation, the introduction of removable bridgework followed, and innumerable methods and devices for the construction of structures of this type also have been presented from time to time.

Removable bridgework, however, is susceptible equally to indiscriminate and injudicious application, and is not a panacea for all defects and faults to be found in other methods.

Both fixed and removable bridgework have passed through the experimental stages. Each has done much damage and has caused the loss of many good teeth. The failures, however, were attributable more largely to overenthusiasm, to indiscriminate application and to faulty technic, than to incorrect principles.

Typical cases showing a flagrant indifference to the requirements of

strength in fixed bridgework, and an indifference which could only invite and result in failure, are illustrated in Fig. 213. And typical cases showing an indifference to the requirements of *stress* in the application of removable bridgework which could only invite and result in failure are illustrated in Fig. 214.

Methods.

In the replacement of missing teeth there is no one best line of procedure, and no one best method. The conditions and requirements are so varying, and the highest possibilities are so exacting that no one line of procedure, and no one method possesses a range of application sufficiently broad to meet the demands of universal usefulness.

Nearly all of the accepted methods and practices of today have a place, a range of application, and a field of usefulness, when selected with intelligent discrimination, and good judgment, and when the application is made skilfully.

To use intelligent discrimination in the selection of the particular method of procedure which seems adapted best to the case at hand, demands that one must be familiar, first, with all methods and must know the advantages and disadvantages of each. One must be a keen observer of cause and effect also, and must possess an unprejudiced judgment, to a degree which will result in the selection of the particular method by which he can obtain the best results.

The physiologically ideal method of replacing missing teeth is not yet within the range of the most hopeful vision, and until such time as the ideal procedure in all cases is possible, all methods of replacement must be but a choice of evils.

Classification.

In all cases where any number of natural teeth remain, in either arch, the replacement of missing teeth may be effected successfully by any one of three different methods, namely: fixed bridgework, removable bridgework and clasp dentures.

Whenever the number and distribution of the remaining natural teeth is favorable, and where teeth favorable to the requirements in all respects may be used for the purpose of attachment and support for the structure which is to supply the missing teeth and afford the restoration required, fixed or removable bridgework may be used. But where the number and distribution of the remaining natural teeth is unfavorable to the physiological and mechanical requirements of bridgework of any type, then a clasp denture is indicated.

Fixed Bridgework. Fixed bridgework embraces that type of fixture which is designed to be attached securely and permanently to the abutment teeth which support it. It thus becomes a fixed part of the denture. And becoming a fixed part of the normal denture, the requirements of hygiene and sanitation demand that no part of the structural formation ever should cover the subjacent mucosa.

Removable Bridgework. Removable bridgework embraces that type of structure which is designed to rest firmly upon the subjacent mucosa and which is held in place by some means of retaining attachment, and where the retaining attachment itself assumes the entire burden of the stress imposed, affords fixation and stability when in position, and yet admits of removal and replacement without destroying the integrity of any of the parts.

In the structural formation of removable bridgework, some form of "saddle" resting firmly upon the subjacent mucosa always must supplement the retaining attachment. The use of a saddle adds strength to the body of the structure, stabilizes its retention, and admits of restoration.

Type. In the construction either of fixed or removable bridgework, the type varies with the requirements of the case, but all cases may be classified as simplex, compound, complex and cantilever in type.

Simplex. Bridgework of the simplex type may be either anterior or unilateral, and involves the replacement of one or two teeth and never more than three teeth of similar functional activity.

Compound. Bridgework of the compound type may be either anterior, unilateral, or antero-posterior, and involves the replacement of more than two teeth, and of teeth of different functional activity.

Complex. Bridgework of the complex type may be antero-posterior, or bilateral, and embraces the replacement of any great number of teeth of different functional activity in one structure.

Cantilever. Bridgework of the cantilever type may be unilateral, antero-posterior, or anterior, and embraces that type in which positive fixation obtains at one end only, and where a simple rest, or a support in the form of a flexible or movable joint obtains upon the other end.

Assemblage. The application and construction of all forms of fixed or removable bridgework involve the assemblage of abutments, attachments and pontics.

Abutments. The natural teeth which are used for the purpose of attachment, and which afford retention and support to the structure, are known as the abutments.

Attachments. In fixed bridgework the mechanical agency which is used to attach the fixture to the abutment, whether it be full crown, a partial crown, an inlay or any variation of these types, is known as the attachment.

Retaining Attachments. In removable bridgework of any kind, the mechanical agency which is to support and retain the structure in its relation to the abutment, and which admits of removal and replacement is known as the retaining attachment.

Pontics. The artificial substitutes for the missing natural teeth, which form the intermediaries between or adjacent to the attachments, are known as pontics.

Requirements.

In the application and construction of bridgework of any type, certain physiological and mechanical requirements must obtain and be observed always.

Physiological. The physiological requirements demand:

First: That a state of health exist in the teeth which are to be used for abutments, and in their investing and environmental tissues.

Second: That normal conditions be reproduced and simulated as closely as possible.

Third: That the adaptation of all attachments to all abutments be made in a manner which will preclude mechanical irritation and which, therefore, will not invite pathological changes.

Mechanical. The mechanical requirements demand:

First: That all abutments be prepared properly to receive and accommodate the attachments, and to withstand the influences of stress.

Second: That all attachments possess strength adequate to the requirements of stress, and that all requirements of occlusion should be adequately met.

Third: That the structural outlines should be adapted to all requirements and that adequate inherent strength to support the pontics while functioning should obtain.

Fourth: That the pontics be so formed and so shaped as to meet the demands of strength, sanitation, and esthetics to the highest degree possible.

Occlusal Stress.

A knowledge of the influence of stress in mastication is one of the most important basic requirements incident to the successful application

of any form or type of bridgework. While cases requiring the replacement of missing teeth rarely ever present with absolutely normal occlusion, still, even if they did, the same knowledge would be essential.

Incision, prehension and trituration are the functions of the teeth of mammals. These activities obtain as a result of the opposing forces of the mandibular teeth against the maxillary teeth. The direction in which the teeth move in functioning varies with the teeth brought into play, and the stress imposed upon the anterior teeth in incision, or upon the cuspids and first bicuspids in prehension, or upon the second bicuspids and molars in trituration, is not the same either in direction or in intensity.

In incision the forces expressed drive the upper incisors upward and outward, and the lower incisors downward and outward.

In prehension the forces expressed drive the upper cuspids outward and slightly upward, and the lower cuspids inward and slightly downward. The forces of stress received by the upper bicuspids drive them upward, outward and backward, while the lower bicuspids are driven downward, inward and slightly forward. The upper molars are driven outward, backward and upward, while the lower molars are driven inward, backward and downward.

All of the teeth yield to stress in these directions first, but in assuming their normal positions again, they, of course, move back, or in the opposite direction.

Thus they move continually, as stress is initiated or released, and all of these conditions must be observed in order that they may be accommodated.

Traumatic Occlusion. The influence of trauma upon the investing tissues in restorations of any type must always receive careful consideration.

Traumatic occlusion includes abnormal occlusal stress which is capable of producing, or has produced an injury to the periodontium. This is a condition which exists frequently, and often is not recognized until too late. It may occur in cases in which a full complement of natural teeth is present; and it is found, almost invariably, whenever the dental arch is weakened by the loss of one or more teeth. Therefore, it may be found in all classes of cases and under all conditions.

Traumatic occlusion obtains whenever one tooth strikes the opposing tooth, or teeth, with more force than the other teeth strike. And the greatest injury is not produced so much in the act of mastication, where the stress is cushioned by food, as it is by direct contact of tooth upon tooth, as in swallowing. In the act of swallowing it has been estimated that from three to eight pounds of stress is imposed.

In bridgework, if the supporting teeth are normal and healthy, the opposing teeth will respond to traumatic occlusion before it manifests in the supporting teeth themselves. Hence, if traumatic occlusion exists in the natural teeth, it may be produced by a simple filling, by a crown, or by a restoration of any type. And when this condition is discovered it must be corrected.

In the application and construction of bridgework, therefore, all the requirements of functional occlusion must be carefully accommodated, and

FIG. 215.

every effort should be made to avoid traumatic occlusion. And no restoration, whether fixed or removable, ever should be inserted, nor ever will be successful unless functional occlusion obtains. Whether it be a single crown or a bridge of the most complex type, every precaution must be taken to avoid traumatic occlusion, and to insure a restoration of normal function.

A carbon paper known as "articulating paper" is prepared for this purpose and always should be used as a means of checking up and finally perfecting the construction to meet occlusal requirements.

Phonation.

The structural design in any and in all of its details, and irrespective of whether fixed or removable, must be made in such manner as to offer no appreciable impediment to correct speech.

A dental restoration of any type must offer no interference with normal enunciation and this will obtain only when normal outlines are reproduced, and when the conformation and adaptation are favorable.

Combination Fixed and Removable Bridgework.

Various methods of combining the advantages both of fixed and removable structures in a single appliance have been suggested. Many of the suggestions are ingenious, but all of them are more or less intricate, and none of them ever has been accepted as a useful method of procedure.

Generally, appliances of this type embrace adjustable retaining at-

tachments which, when placed in position on the supporting teeth, are then locked with a small screw. (Fig. 215.) This admits of removing, cleansing and replacing the appliance at intervals sufficiently close to insure some degree of sanitation.

The psychological aspect of the possibilities of sanitation, however, is the only feature of advantage possessed by this type of construction, and it never has been used extensively. The best results are obtained from the use of an appliance which either is fixed definitely and positively, or which is removable definitely and easily.

Clasp Dentures.

Clasp dentures embrace that type in which the subjacent soft tissues support the body of the denture and assume the burden of the stress imposed, the clasps acting as a retaining medium only, except where the clasp is supplied with an occlusal rest, in which case the burden is shared by the abutment teeth.

The application and construction of clasp dentures do not belong properly to bridgework, yet this type of construction is associated closely with removable bridgework. Clasp dentures are indicated and often used in preference to removable bridgework because of greater simplicity, and because the application requires no preparation, and, therefore, less immediate destruction of the abutment teeth.

Selection of Methods.

In the selection of the method which seems best adapted to the case at hand, it must be remembered that conditions vary to such an extent that no mechanical device which is designed to become a part of the human economy is applicable universally.

Each case presenting must be studied carefully from the viewpoint of the foundation, first, and the requirements of health, hygiene, occlusion and stress must be considered before the selection can be made intelligently.

And when the selection has been made, it must be made conscientiously and with a view to accomplishing the replacement, not in the simplest manner, nor by the easiest method, but in the best manner and by the method best for the case in hand.

"The thing easiest to do rarely is done well," is a truism applicable to bridgework, because any method used in the replacement of missing teeth is not easy if the highest achievements are to obtain.

CHAPTER XV.

FIXED BRIDGEWORK.

Modern fixed bridgework has been a common feature of practice for many years. The possible advantages that may be obtained from the replacement of missing teeth by means of an attachment fixed to remaining natural teeth were recognized early, and were alluring.

"Teeth without plates" became a psychological magnet, and many were carried away on a wave of enthusiasm. As a result, all other methods of replacing missing teeth, except in edentulous cases, were forgotten temporarily by many, and the virtues of fixed bridgework were championed and extolled to a point beyond the limits of reason.

Those were pioneer days, however, and the methods were pioneer methods. The application met with varying degrees of success and failure.

Some, overenthusiastic, used fixed bridgework to the exclusion of all other methods. Those who did, soon encountered failures. The more conservative, however, soon recognized possible disadvantages, and possible reasons for failure. They made an effort to eliminate or to minimize both, and to use this method, not to the exclusion of all others, but where it seemed to be a rational procedure.

Others, who were less analytically inclined, were so influenced by the percentage of failures, as to become discouraged, and, ultimately, criticized and even condemned fixed bridgework in whole and in part.

The criticism and condemnation, however, have been productive of much good, and have reacted in such manner as to revolutionize former methods of practice, and to place the skilful application of modern fixed bridgework in its proper place, as one of the useful methods of replacing missing teeth.

The use of fixed bridgework to the exclusion of all other methods of replacing missing teeth was a practice that justified criticism and condemnation.

Like any other one method of procedure, this one is not universally applicable. And, like all other methods that may have an elastic range of application and an extensive field of usefulness, it has been abused. And when any method is abused by indiscriminate, overzealous and incompetent application, criticism must follow, and condemnation often is warrantable.

Heretofore, fixed bridgework has been a mass of empirical methods, applied indiscriminately. Possible injury to the supporting natural teeth, and the requirements of hygiene and sanitation have been ignored largely. Both considerations are vital issues always. The conservation, promotion and maintenance of health must be the fundamental consideration in the replacement of missing teeth by any method. And the application of any method which does not involve and include favorable possibilities in these directions is to be regarded as approaching the border line of malpractice.

In the application of fixed bridgework, therefore, the conservation of the health of the supporting natural teeth is the first consideration, and hygiene and sanitation follow closely as basic requirements.

A certain amount of injury to the supporting natural teeth must follow the replacement of missing teeth by any method, irrespective of whether the restoration be of the fixed or the removable type. But unless the partial immobilization of the supporting natural teeth which follows the application of fixed bridgework, in itself, is absolutely detrimental to the health and vitality of the teeth so treated, then no greater injury results, necessarily, from one method than from another.

Fixation as a Principle.

The "fixation," or the partial immobilization of natural teeth which follows the application of fixed bridgework, therefore, is a consideration of importance, theoretically and physiologically, at least, because nothing quite analogous is attempted otherwise, or, in so far as is known, is tolerated by Nature.

Biology teaches that "the function of normal tissues in organs at work cannot be violated seriously, without impairing the vitality of the organs involved." In the partial immobilization of the natural teeth, the normal functioning movements are restricted necessarily, and, to a degree, an abnormal condition is established. But whether the limited restriction of movement, or the establishment of a condition which is not physiologically ideal, will invite or produce a pathological condition, is doubtful, and is not proven by clinical evidence so far.

It is true that Nature does not tolerate absolute fixation, nor absolute immobilization, of any tissues in the body which move in functioning, and that where this condition obtains indefinitely, degeneration and atrophy follow. And it is true, too, that all movable tissues require a certain amount of exercise and stimulation in order that health may be promoted and maintained.

Also it is true that teeth move in functioning and that a reasonable amount of exercise and stimulation is essential to the health of their investing and environmental tissues. And it is true also that inflammation begins with stasis, and that prolonged stasis of circulation, at any given point, will be followed by degeneration and atrophy.

These biological principles apply to the teeth as well as to other tissues, and, doubtless, would obtain and follow in sequence if the teeth were to be, or if they could be, immobilized absolutely and permanently. But the teeth are not entirely analogous with any other tissues in the body. They are cushioned peculiarly by their investing tissues, and they are cushioned in such manner, and by tissues of such character, and of such tolerance, as to make complete and absolute immobilization practically impossible.

As a strictly hypothetical proposition: If the full complement of teeth in either arch were to be banded first as single units, and if the bands were assembled into one major fixture, and this fixture then cemented to place upon the teeth, absolute fixation, or complete immobilization, would not obtain. Some movement, even though restricted, and limited, and far from normal, would be possible because of the character and resiliency of the investing tissues.

A lowered tonicity and resistance of these tissues would follow, of course, but, so long as some degree of normal functioning activity were possible, a pathological condition would not be invited, necessarily.

Therefore, if complete and absolute immobilization of the teeth practically is impossible, and if the investing and environmental tissues will tolerate partial immobilization, then fixed bridgework is a rational and useful method of supplying missing teeth, and its application often may be indicated as the choice of evils, or as the lesser evil.

Clinical evidence, extending over a period of many years, indicates beyond a reasonable doubt, that the degree of immobilization which follows the application of well designed, and well built, and properly adapted fixed bridgework does not condemn teeth, necessarily, nor condemn the vitality of their pulps, nor invite a pathological condition.

And it is noteworthy to observe, too, that pulpless teeth are tolerated under these conditions quite as well as are teeth having vital pulps; also, that partial immobilization, instead of insuring an impairment of the vitality and usefulness, and the ultimate loss of teeth so treated, on the contrary, frequently adds to their usefulness and longevity.

Indeed, teeth which have lost the support and protection previously afforded by adjacent and opposing teeth, where the investing tissues are of low tonicity, and where usefulness and comfort are negative, often may be made comfortable and serviceable for many years by stabilizing them.

In many instances of this kind partial immobilization is not only not injurious, and not destructive, but is a positive restorative measure.

Therefore, while it cannot be claimed that a physiologically ideal condition follows the application of fixed bridgework, and while it is apparent that a semi-, or a quasi-abnormal condition obtains, still it is evident that Nature does and will tolerate a partial immobilization of the natural teeth, and that teeth so immobilized, with all other conditions made favorable, may and do remain healthy and serviceable for many years.

Like collateral circulation, and like the accentuation of the remaining senses following the loss of one, and like many other physiological phenomena, these clinical truths afford only another evidence of the resourcefulness of Nature.

Advantages. In the replacement of missing teeth by any method the aim should be: First, to obtain a maximum of efficiency in the restoration of function; and, second, to obtain this maximum of efficiency with a minimum of injury to the supporting natural teeth.

Functional efficiency increases with stability and decreases with mobility. Hence, in proportion as any type of restoration is stabilized in functioning, its efficiency will be increased. Absolute fixation, therefore, insures the maximum of stability.

In addition to the important feature of increased efficiency, the modern methods of attachment require less destruction of the supporting natural teeth for fixed bridgework than is required for any type of removable bridgework, other than clasp dentures.

Indications. Fixed bridgework is indicated and may be used successfully, whenever the application may be made under favorable conditions and within reasonable limitations.

Favorable conditions mean that health must obtain, primarily, in all teeth which are to be used as abutments; and reasonable limitations mean that a knowledge of the basic laws of mechanics, or of dynamics in particular, must obtain, and must be applied in each and every case. Irrespective of however well fixed bridgework may be built and adapted, no case will be successful unless sound mechanical principles are followed throughout its construction and application.

The ideal and most typical indications for the use of fixed bridgework embrace:

First: those cases where only a few teeth are to be replaced in a single fixture: and, second, those cases where teeth of similar functional activities only are included in the same fixture.

While it is not imperative that only teeth of similar functional activi-

ties should be included in a single fixture, a more typically physiological condition obtains, undoubtedly, whenever the normal functioning movement of the supporting natural teeth is restricted to a minimum extent, rather than to a maximum extent.

In grouping the teeth of similar functional activity, the four incisors and cuspids, moving in the same general direction in functioning, may be linked together and designated as Group No. 1. The bicuspids and molars, moving in the same general direction in functioning, may be linked together and designated as Group No. 2. The most ideally successful results will be obtained when the dental arches are divided thus into three segments, each segment embracing and including only teeth of similar functional activities, as follows:

Group No. 1. Any combination of abutments and attachments which is confined to the six anterior teeth, exclusively.

Group No. 2. Any combination of abutments and attachments which is confined to unilateral groups embracing the bicuspids and molars only.

The distribution of the abutment teeth in either group is important, and, usually, the number of abutment teeth should be equivalent to the number of missing teeth to be supplied. This rule is not imperative, however, because the strength of the abutment teeth in their relation to the requirements of stress is the controlling factor in all cases.

Clinical evidence proves conclusively that the teeth will withstand and will tolerate a burden of stress in excess of normal functional demands. But the extent to which they may be expected to assume this additional burden, and the duration of expected toleration, must be within the limits of reason.

Under favorable conditions one tooth will do the work of two teeth, but to do the work of two teeth, the abutment tooth must be supported or protected against the influence of excessively abnormal stress. This is an imperative rule in all cases. The simplest application of this rule may be made in the replacement of a single missing tooth by attachment to a single abutment.

Supplying Missing Teeth.

Supplying a Single Missing Tooth. A single abutment will support a single pontic, only under favorable conditions, and favorable conditions demand: First: that the abutment tooth be the larger and stronger; and, second, that it must be protected against the influence of the additional and abnormal stress to which it will be subjected.

In supplying a single pontic by attachment to a single abutment, the

abutment acts as the fulcrum and the pontic becomes a lever. Hence, the power of the lever is exerted upon the abutment tooth at all times. As a result of the continued influence of stress, increased by the power of the lever, the abutment tooth will yield, and it will yield in the line of least resistance.

In the posterior teeth, this line of least resistance is toward the edentulous space. Posterior pontics, therefore, must be supported against stress in the line in which the preponderance of stress is received, which is in a vertical direction. Hence, posterior pontics must be supported against vertical stress.

In the anterior teeth, where the roots are of conical formation, usually, yielding to the line of least resistance, the influence of stress would result in an outward and rotary displacement of the upper teeth, and in an inward and rotary displacement of the lower teeth. Hence, a suspended anterior pontic must be supported against lateral stress, or stress which would result in torsion, or in the rotation of the abutment tooth on its long axis.

Therefore, in supplying a single posterior pontic by attachment to a single posterior abutment, an extension resting into or upon the occlusal surface of the natural tooth, adjacent to the pontic, is necessary always and when adjusted properly will support the abutment tooth adequately against both vertical and lateral stress.

The same provision must obtain in the anterior teeth also and all anterior abutments to which pontics are suspended must be protected against torsion, or rotation, on their long axes. A simple rest upon the lingual surface of the natural tooth adjacent to the pontic will meet the requirements in this respect.

These mechanical requirements must be provided in all cases where a single pontic is suspended from a single abutment, except, perhaps, in cases where the first molar is used to support a missing second bicuspid. The normal size and stability of the first molar in such cases, as compared with the size and requirements of the second bicuspid, do not make such provisions imperative in all cases, though the strain upon the abutment tooth would be lessened and the efficiency of the pontic increased, if this provision is supplied even in these cases.

Supplying Two Missing Teeth. In supplying two missing teeth, two abutments are necessary in all cases, irrespective of whether the teeth to be replaced are adjacent to each other, or are separated by one of the abutment teeth.

The most typical fixed bridgework is that type which is attached to

abutments at each extreme end, however large or however small the fixture may be, but this typically favorable condition is not imperative. It is not imperative because when the distribution is favorable, one pontic may be suspended. But a suspended pontic must be suspended anteriorly of the first molar and anteriorly of its attachment to the abutment tooth.

This rule is imperative because the maximum of occlusal stress centers in the first molar, and diminishes proportionately with each tooth anterior thereto, and because no suspended pontic should be placed where it will be subjected to a degree of stress exceeding the stress imposed upon and assumed by the supporting abutment.

Anterior Teeth. In replacing two anterior teeth the attachments must be securely fixed to the abutment teeth in all cases.

Posterior Teeth. In the replacement of posterior teeth, either a fixed attachment at both ends or the cantiliver type of fixture may be used successfully.

Cantilever Type. A fixed attachment at one end and a movable joint at the other end of small posterior fixtures often is advantageous, but the possible advantages and usefulness of this type of construction are limited to cases in which one, and never more than two, pontics are supplied.

Because of the difference in the normal functioning activities of the cuspids and the first bicuspids, the cantiliver type of construction often may be used to advantage in fixtures which involve these particular teeth.

A movable joint between cuspid and first bicuspid, when it may be supplied without weakening the fixture, is a physiologically ideal type of construction because of permitting the abutment teeth to function independently of each other, but it is not imperative that a movable joint should be placed at this point in all cases.

As an example: A missing cuspid may be supplied successfully by attachment to the first bicuspid alone. And a missing lateral incisor and a missing first bicuspid may be supplied by attachment to the cuspid and second bicuspid in a single fixture, and with or without a movable joint between the cuspid abutment and the bicuspid pontic.

Field of Usefulness.

With the preceding fundamental principles as a basis, the range of application and the field of usefulness of fixed bridgework, of each of the four basic types, may be classified as follows:

Fig. 216.

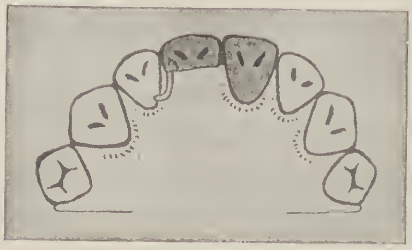


Fig. 217.

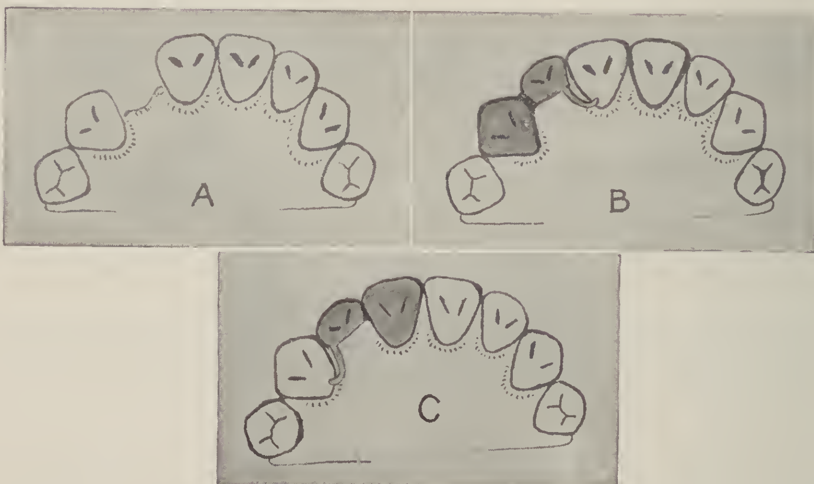


Fig. 218

FIG. 219.

FIG. 220.

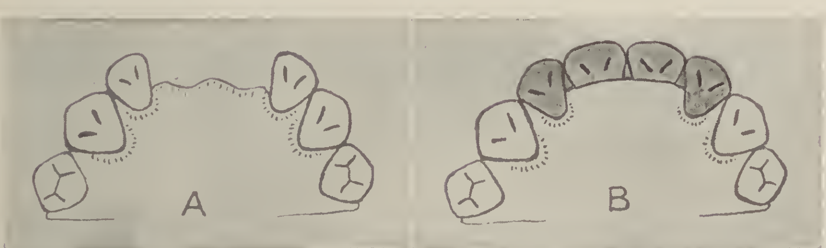


FIG. 221.

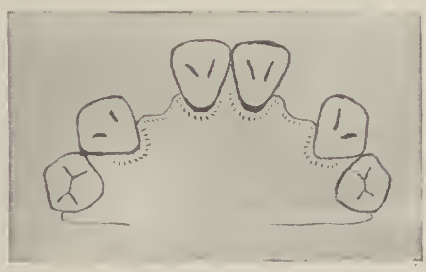


FIG. 222.

Simplex Type.

The range of application of fixed bridgework of the simplex type embraces all small fixtures involving teeth of similar functional activities, mainly, as classified previously in Groups No. 1 and No. 2.

Group No. 1.

Class 1.—Replacing Missing Central Incisor. In replacing a missing central incisor (Fig. 216 A), the pontic should be supported both by mesial and distal attachments, each fixed to the abutment teeth. (Fig. 216 B.)

A fixed attachment to the adjacent central incisor alone, together with a simple rest upon the lingual surface of the lateral incisor (Fig. 217), might answer the purpose in some cases, but a maximum degree of stability and permanency would not be obtained in this manner.

Any type of attachment to the central incisor alone would be entirely inadequate in either arch.

Class 2.—Replacing Missing Lateral Incisor. A missing lateral incisor (Fig. 218 A) may be supported adequately by attachment to the cuspid (Fig. 218 B) or to the central incisor, (Fig. 218 C) only, but in either case a lingual rest must be placed aganist the tooth not used as an abutment.

Rotation of the abutment tooth on its long axis invariably would follow a failure to observe this precaution, and a misalinement of the pontic, as indicated in Fig. 219, soon would result.

A definite fixed attachment both to the central incisor and the cuspid, as illustrated in Fig. 220, however, is entirely unnecessary. Either one of the abutment teeth is sufficiently strong to support the missing lateral incisor, when a provision against rotation is made; therefore, a simple rest against the tooth not used as an abutment would answer the purpose of fixation, and offer no interference with the normal functioning movement of either tooth, which would be advantageous.

Class 3.—Replacing Missing Central Incisors. In replacing the two central incisors (Fig. 221 A) a secure fixed attachment to the two lateral incisors (Fig. 221 B) will prove adequate in most cases, where the conditions of occlusion are favorable. Owing to the relative weakness of the roots of the lateral incisors, however, a successful and permanent fixture will obtain only when these conditions are favorable.

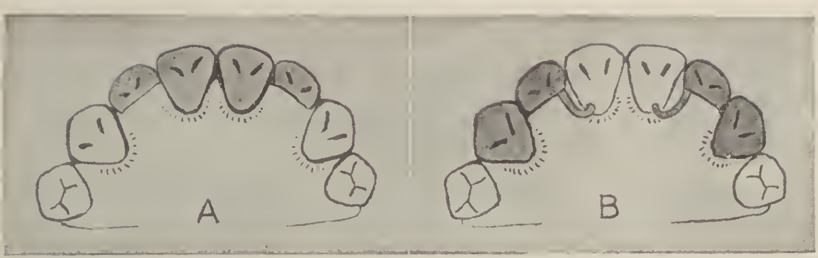


Fig. 223.

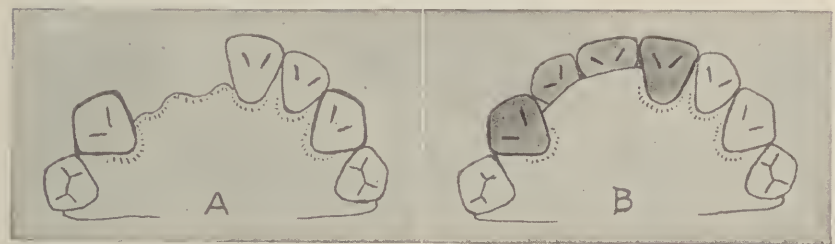


Fig. 224.

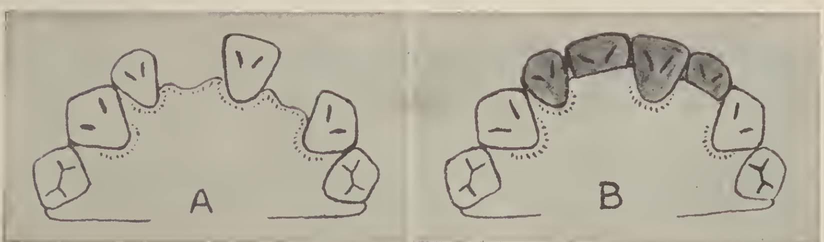


Fig. 225.

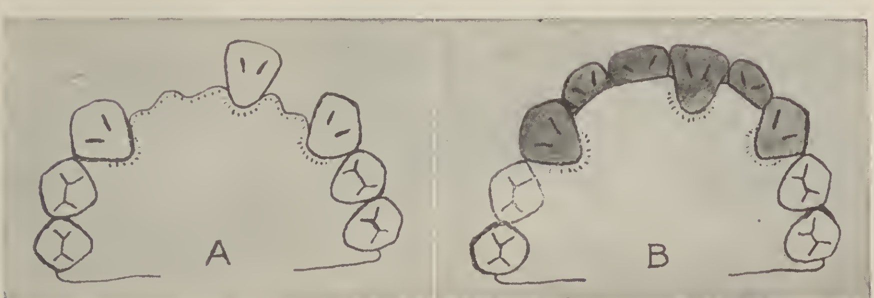


Fig. 226.

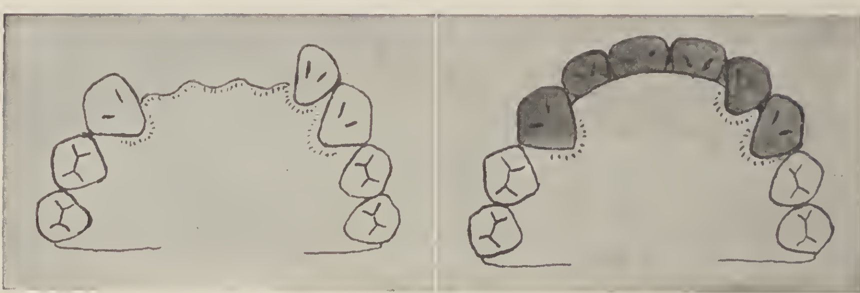


Fig. 227.

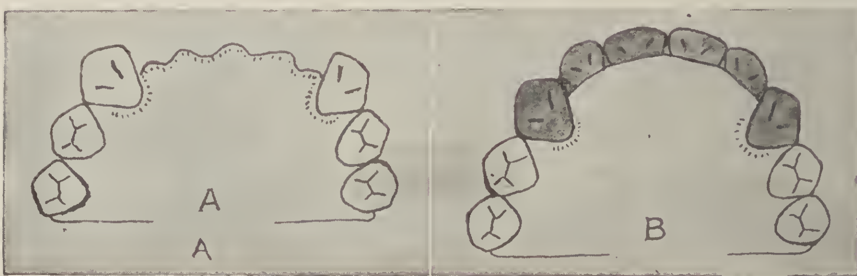


Fig. 228.

Class 4.—Replacing Missing Lateral Incisors. Missing lateral incisors (Fig. 222) may be replaced successfully, by either of one or two methods of procedure. First, a fixed attachment to the two central incisors will support the laterals in a more or less secure and permanent manner. (Fig. 223 A.) And, second, a fixed attachment to each cuspid, with a simple lingual rest against the central incisors, thus making two independent fixtures, will answer the purpose. (Fig. 223 B.)

A choice between these procedures should depend upon the presence of caries, fillings, or other defects in the crowns of the teeth to be used as abutments, and those having defects of any kind should be used in preference to good, sound teeth in all cases.

Class 5.—Replacing a Missing Central and Lateral Incisor. A missing central and lateral incisor, adjacent to each other (Fig. 224 A), may be supported successfully by a fixed attachment to the cuspid and central incisor. (Fig. 224 B.)

When the missing central and lateral incisors are not adjacent to each other (Fig. 225 A), the attachment should be made to the remaining central and lateral incisors, in which case it is not necessary to include or involve either cuspid. (Fig. 225 B.)

FIG. 229 A.

FIG. 229 B.

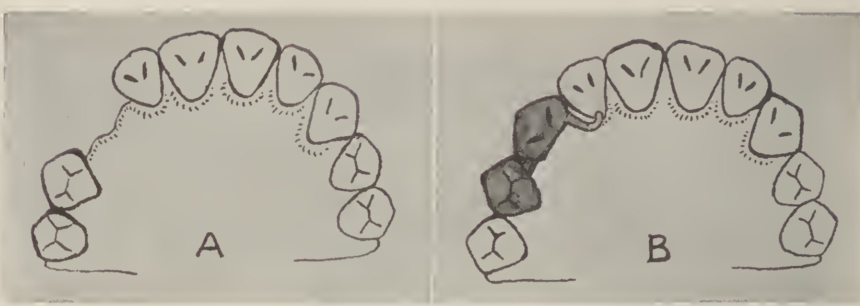


FIG. 230.

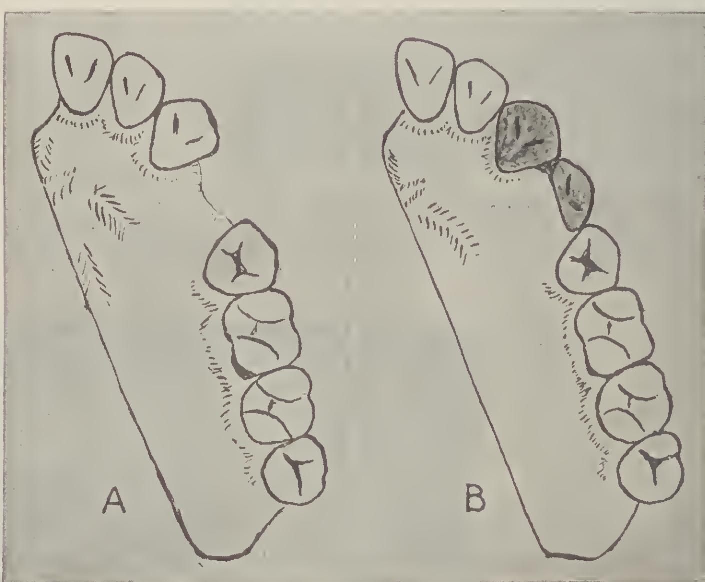


FIG. 231.

Class 6.—Replacing Missing Central and Both Lateral Incisors. The two cuspids and one remaining central incisor (Fig. 226 A) will support the missing central and two lateral incisors successfully. The presence of the intervening central incisor will stabilize the fixture and insure permanency. (Fig. 226 B.)

Class 7.—Replacing Missing Centrals and One Lateral Incisor. The two cuspids and one lateral incisor also will support the missing centrals and lateral successfully. The compound anchorage at one end also stabilizes the fixture and insures success. (Fig. 227.)

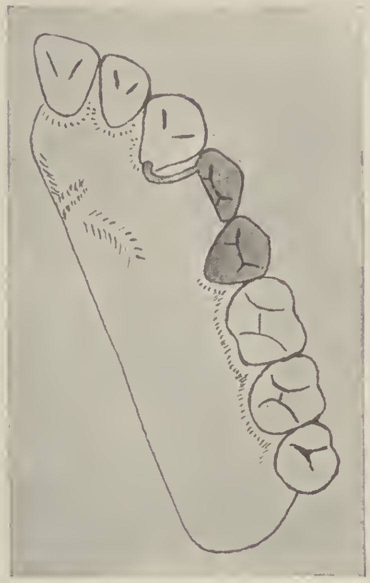


Fig. 232.

Fig. 233.

Class 8.—Replacing Missing Four Incisors. The four incisors (Fig. 228 A), upper or lower, may be replaced successfully by a fixed attachment to both cuspids (Fig. 228 B), and the strength and stability of the cuspid teeth insures a more or less permanent fixture usually.

The most satisfactory results are obtained, however, in cases where any great overlapping of the upper teeth upon the lower teeth does not present (Fig. 229 A), but where an incisal relationship, which is more nearly end to end obtains. (Fig. 229 B). As a means of preventing anterior protrusion, this relationship should obtain whenever possible.

Class 9.—Replacing Missing Cuspid. A first biscuspid will support a missing cuspid successfully. (Fig 230 A). While the first bicuspid is a good, strong, and well-balanced abutment, usually, still a lingual rest upon the adjacent lateral incisor is a safe precaution against misalinement. (Fig. 230 B.)

Class 10.—Replacing Missing First Bicuspid. The cuspid will support a missing first bicuspid (Fig. 231 A) successfully in favorable cases, provided that no effort to restore the occlusal surface of the pontic is made. (Fig. 231 B.) If occlusal restoration is demanded, a fixed or a movable attachment to the second bicuspid must be supplied.

The suspension of a first bicuspid pontic from a cuspid abutment is classified in Group No. 1 because the cuspid tooth, which belongs in this group, is involved, principally.

Group No. 2.

Class 1.—Replacing Missing First Bicuspid. A missing first bicuspid may be replaced in the best and most permanent manner by means of a fixed attachment to the second bicuspid.

The conical formation of the root of the second bicuspid, however, demands a rest against the lingual surface of the cuspid as a provision against rotation and displacement. (Fig. 232.) This provision must be supplied in all cases, and at all times, and as a further means of diminishing the stress necessarily assumed by the abutment in these cases, the pontic never should possess a full occlusal surface restoration.

Any appreciable amount of restoration of the occlusal surface of first bicuspid pontics is never necessary. These particular teeth assume but a minimum of actual masticatory stress, normally, and as a rule, the pontic used in effecting the replacement never should be required to assume any great burden of stress.

Class 2.—Replacing Missing Second Bicuspid. The first molar will support the second bicuspid successfully where no attempt is made

FIG. 234.

FIG. 235.

Fig. 236.

to restore the occlusal surface of the second bicuspid pontic. (Fig. 233.) If occlusal restoration is demanded, then either a fixed or a movable attachment to the first bicuspid must obtain.

Class 3.—Replacing Missing First Molar. In the replacement of a missing first molar, the requirements of stress are so great that both mesial and distal attachments must be used in all cases. (Fig. 234.) The attachments may be both fixed, involving the simplex type, or a fixed attachment at one end and a movable attachment at the other end, thus involving the cantilever type, may be used, and either will be successful.

If any appreciable advantage may be obtained from not interfering with the independent movement of the abutment teeth, the application of the cantilever type would be typically applicable in this class of cases.

Class 4.—Replacing Missing First Molar and Second Bicuspid. A second molar and a first bicuspid will support the intervening second bicuspid and first molar successfully because all teeth involved in this class of cases are of similar functional activity; and, because of the length of the fixture and the burden of stress which the pontics must assume, the best results will be obtained from a fixed attachment at each end. (Fig.

FIG. 237.

FIG. 238.

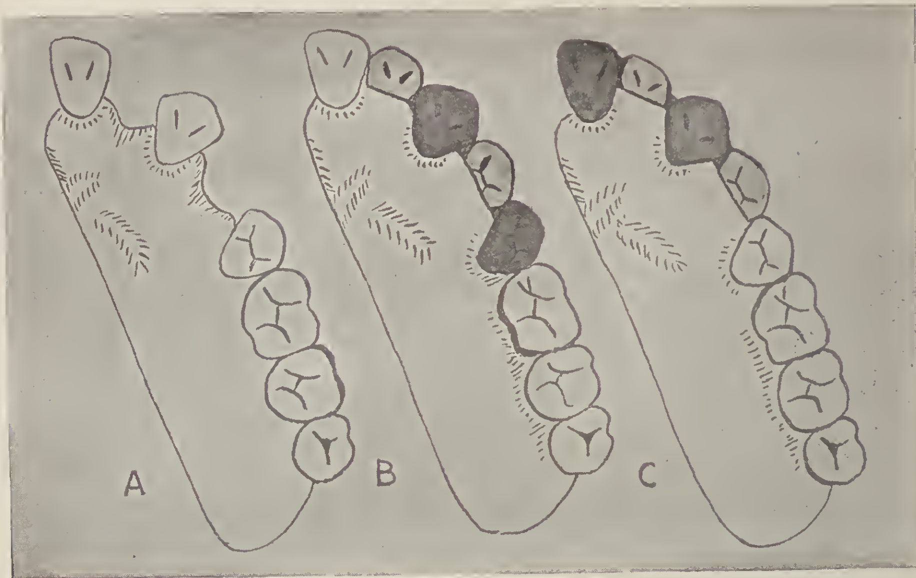


FIG. 239.

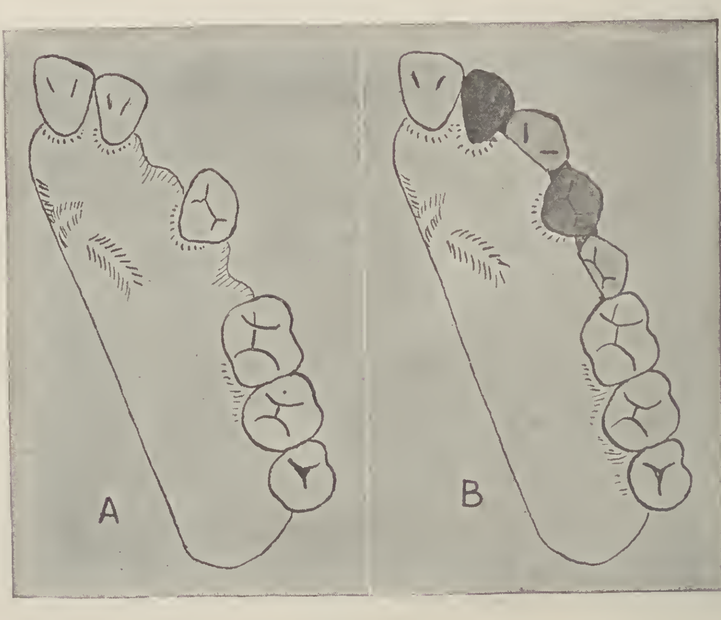


FIG. 240.

235.) This type of fixture is the simplest application of the simplex type of construction to Group No. 2.

Class 5.—Replacing Missing First Molar and First Bicuspid. A missing first molar and first bicuspid may be replaced successfully by a fixed attachment to the second molar and second bicuspid. (Fig. 236.) This also is a typical application of the simplex type of construction to cases classified in Group No. 2.

Class 6.—Replacing Missing First and Second Molars. A third molar and a second bicuspid will support the intervening first and second molars successfully and this also is a typical application of the simplex type. (Fig. 237.) But owing to the burden of stress assumed by the pontics, the best results will result from absolute fixation at both ends of the fixture.

Class 7.—Replacing Missing Second Molar and Second Bicuspid. The third molar and the first molar will support the second molar and second bicuspid, and is a typical application of the simplex type also. (Fig. 238.) The best results in this application of the simplex type also will result from a continuous fixture.

Compound Type.

Fixed bridgework of the compound type differs from the simplex type only in so far as involving teeth of different functional activity, and may be applied successfully to the following classes of cases:

Class 1.—Replacing Missing Lateral Incisor and First Bicuspid. A missing lateral incisor and first bicuspid (Fig. 239 A) may be supplied successfully by attachment to the cuspid and second bicuspid. (Fig. 239 B.) In this application a movable joint between the cuspid and first bicuspid may or may not be used. A movable joint at this point may be advantageous in some cases, but even though the abutment teeth are of different functional activities, successful results will follow the application of a continuous unbroken fixture in the average case. The central incisor and cuspid could be used successfully also, in which case the fixture would belong to the simplex type. (Fig. 239 C.)

Class 2.—Replacing Missing Cuspid and Second Bicuspid. A missing cuspid and second bicuspid (Fig. 240 A) may be replaced successfully by attachment to the lateral incisor and first bicuspid (Fig. 240 B), provided that no restoration of the occlusal surface of the second bicuspid pontic is attempted.

If occlusal restoration of the second bicuspid pontic is desirable, or is

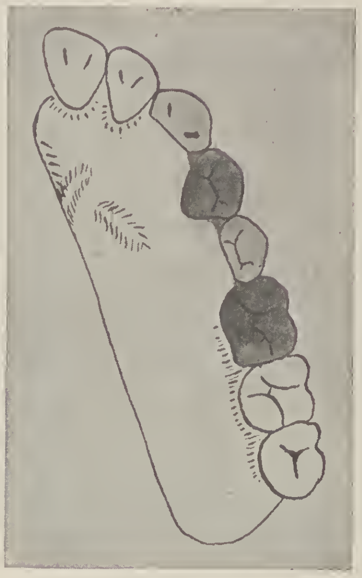


FIG. 241.

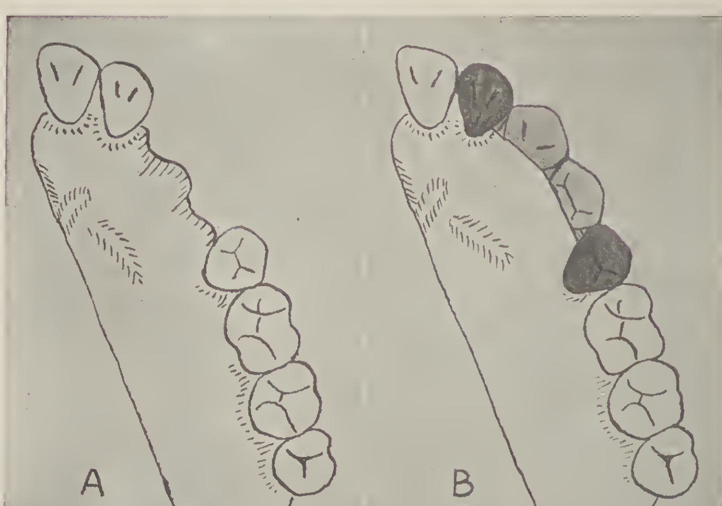


FIG. 242.

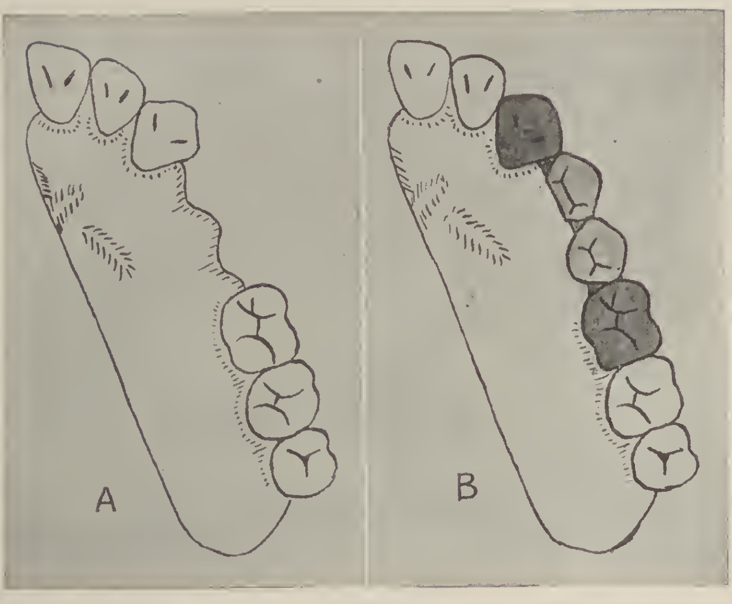


Fig. 243.

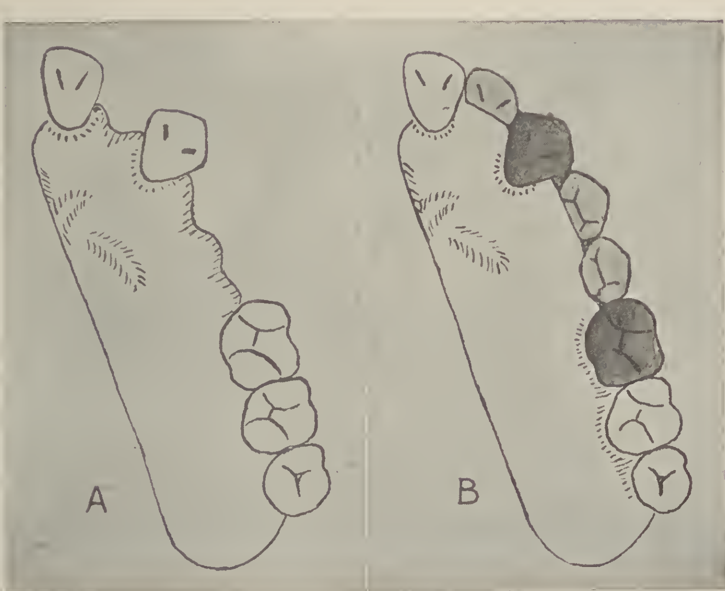


Fig. 244.

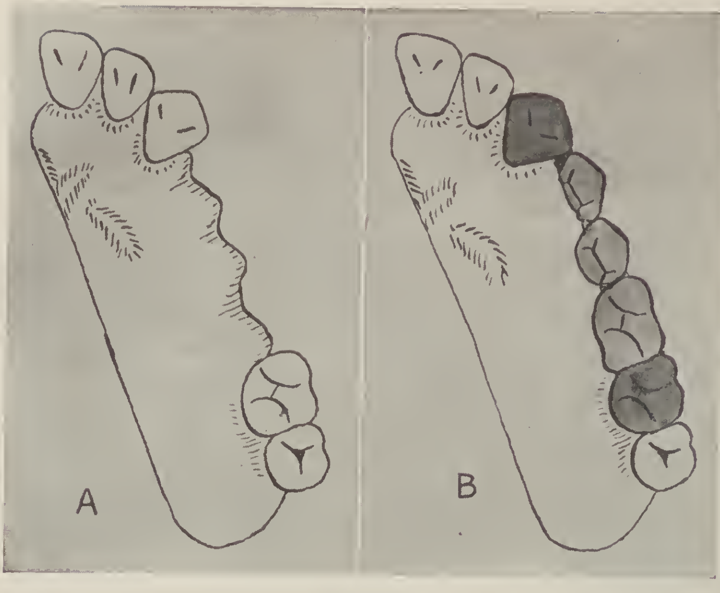


Fig. 245.

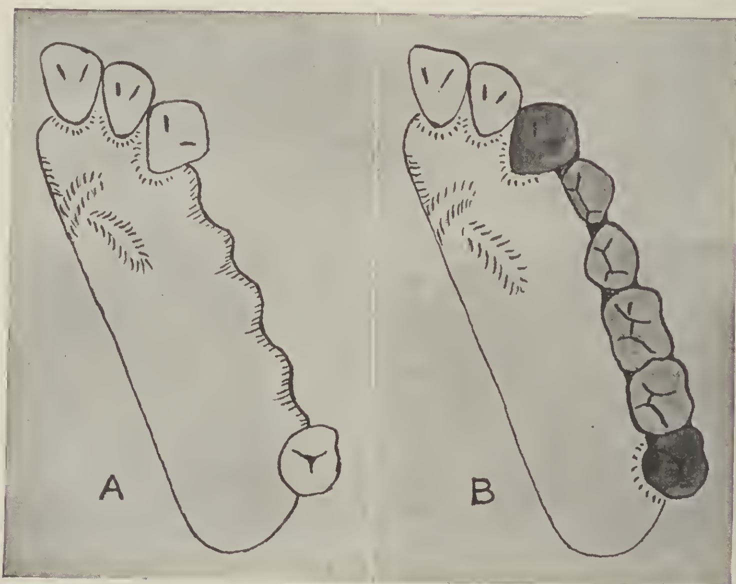


Fig. 246.

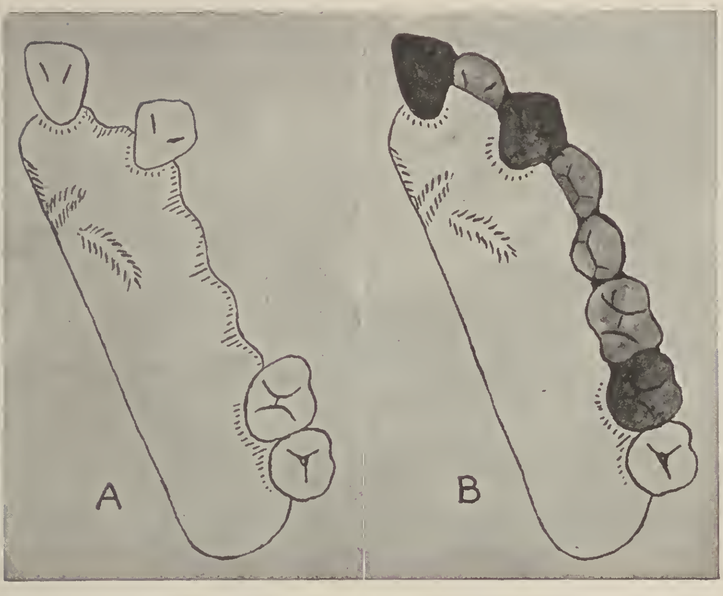


FIG. 247.

necessary, then attachment to the first molar must be made. And when attachment to the first molar obtains, no attachment to the lateral incisor is necessary. (Fig. 241.)

Class 3.—Replacing Missing Cuspid and First Bicuspid. A missing cuspid and first bicuspid (Fig. 242 A) may be supplied successfully by attachment to the lateral incisor and second bicuspid (Fig. 242 B), but owing to the inherent weakness of both abutment teeth, this affords probably the weakest type of compound fixture. Hence it must be made in one continuous fixture at all times, and even then will be of doubtful permanency.

Class 4.—Replacing Missing Bicuspids (Unilateral). The two bicuspids on either side of the arch (Fig. 243 A) may be supported successfully by attachment to the cuspid and first molar. (Fig. 243 B.) Even though teeth of different functional activities are involved, success is insured in the application of this type of case because of the normal strength and stability of the abutment teeth.

Class 5.—Replacing Missing Lateral Incisor and Both Bicuspids. A missing lateral incisor and both bicuspids on one side of the arch (Fig. 244 A) also may be supplied successfully by attachment to the cuspid and first molar. (Fig. 244 B.) The normal strength and stability

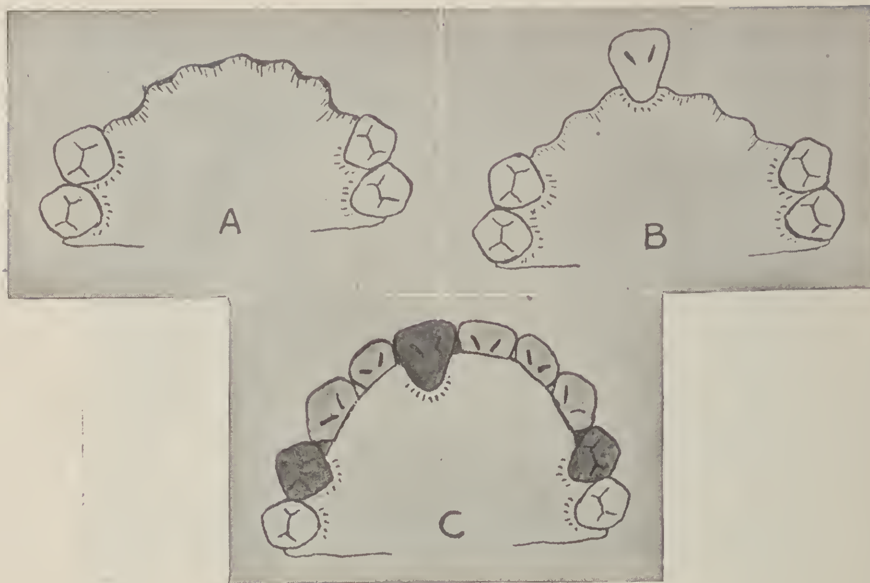


Fig. 248.

of the cuspid and first molar are adequate to the additional requirements of the lateral incisor pontic thus suspended.

Class 6.—Replacing Two Bicuspids and First Molar. The first molar and both bicuspids (Fig. 245 A) also may be supplied successfully in one fixture by attachment to the cuspid and second molar. (Fig. 245 B.) This involves a longer fixture and a somewhat weaker abutment at the posterior end, but under favorable conditions a successful application may be made.

Class 7.—Replacing Bicuspids and First and Second Molars (Unilateral). In cases where the two bicuspids and first and second molars are missing (Fig. 246 A) on one side of the arch only, they may be supplied by attachment to the cuspid and third molar. (Fig. 246 B.) Such cases, however, will overburden the abutment teeth to the extreme limit; hence, the replacement of these teeth usually is best effected by means of some form of removable bridgework. Restoration of lost tissue, also, usually is required in these cases, and such restoration demands the use of a removable structure at all times.

Class 8.—Replacing Missing Lateral Incisor, Bicuspids and First Molar (Unilateral). The most complex application of fixed bridgework of the compound type would involve the replacement of the lateral incisor,

FIG. 249.

bicuspids, and first molar (Fig. 247 A) by attachment to the central incisor, cuspid and second molar in one unilateral fixture. (Fig. 247 B.) The application of a fixture of this size might be made successfully under very favorable conditions, but because of its extensiveness, a removable fixture would be a safer and preferable procedure in most cases.

Complex Type.

The complex type of fixed bridgework embraces all forms of bilateral fixtures in which the replacement of missing teeth on both sides of the arch in one single fixture is involved.

Class 1.—Replacing Missing Incisors and Cuspids. In replacing the six anterior teeth (Fig. 248 A) the first bicuspids alone *will not* support the intervening cuspids and incisors successfully in any form of fixed bridgework. But the first bicuspids, together with any one of the intervening cuspids or incisors (Fig. 248 B), will support the remaining anterior teeth successfully when the requirements of occlusion are favorable. (Fig. 248 C.)

Class 2.—Replacing Missing Incisors and First Bicuspids. The second bicuspids and the cuspids (Fig. 249 A) frequently will support the missing incisors and first bicuspids successfully. (Fig. 249 B.) This type of fixture is approaching the limitations of successful fixed bridge-

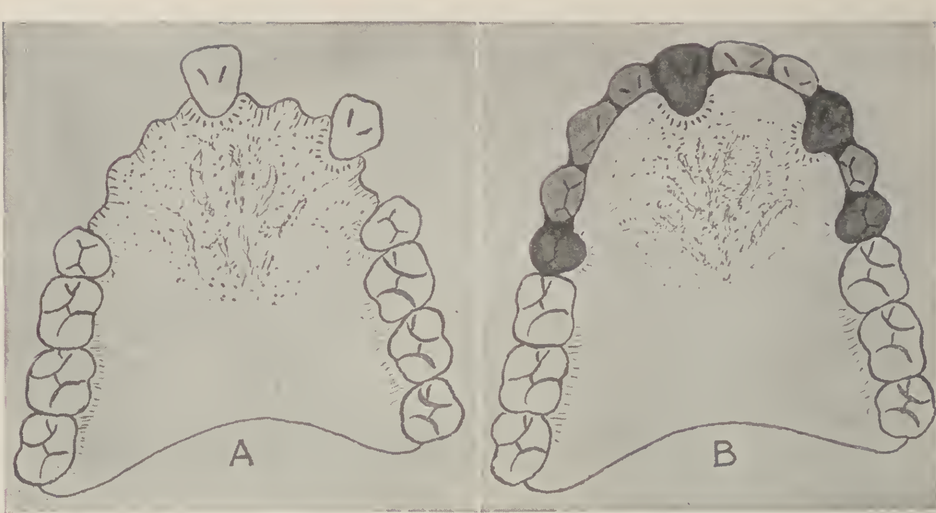


Fig. 250.

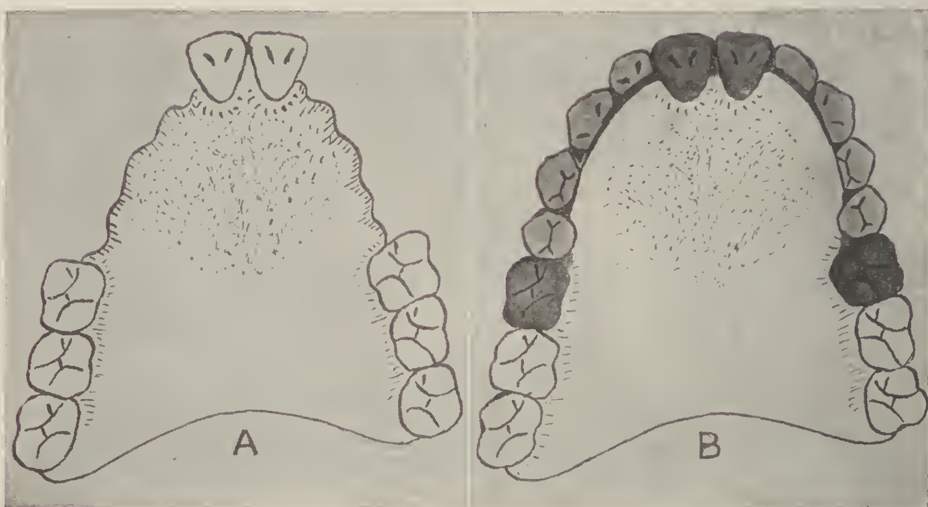


Fig. 251.

work very closely and almost to the borderline of reason, but its application may be successful in cases in which all conditions are favorable.

Class 3.—Replacing Missing Incisors, Cuspid and First Bicuspid. The second bicuspids, together with two other anterior teeth (Fig. 250 A), will support the remaining missing anterior teeth, provided the

Fig. 252.

Fig. 253.

distribution of the abutment teeth is favorable to a more or less equal distribution of stress. (Fig. 250 B.) The entire success of fixtures of this type will depend upon the careful observation of basic mechanical principles in their application, and unless the conditions are favorable to all requirements, a removable structure should be used.

Class 4.—Replacing Missing Lateral Incisors, Cuspids and Bicuspids. Missing lateral incisors, cuspids and bicuspids (Fig. 251 A) may be supported successfully by attachment to the two central incisors and the two first molars. (Fig. 251 B.) The supporting teeth, however, would be overburdened, and the practicability and permanency of the fixture would be so doubtful as to indicate some type of removable structure.

FIG. 254.

Class 5.—Replacing Missing Incisors and Bicuspids. The cuspids and first molars, normally, are the strongest teeth in the arch. Hence, under the most favorable conditions they will support the missing incisors and bicuspids more or less successfully and more or less permanently. (Fig. 252.) Fixtures of this type, however, are the extreme limit in the application of fixed bridgework, and such application should be made only in cases where the requirements of restoration of lost tissue are negative, and where every other condition is favorable. Otherwise, a removable structure is demanded.

Class 6.—Variations. Any variations in the distribution of the abutment teeth, such as is illustrated, for example, in Fig. 253, will not effect the successful application of fixtures of the complex type materially, provided that the distribution is favorable to the basic mechanical requirements.

Cantilever Type.

The cantilever type of fixture is indicated and used most frequently in the replacement of missing first molars and first bicuspids.

Class 1.—Replacement of Missing First Molars. In the replacement of missing first molars, a secure attachment to the second molar, and some form of simple movable joint which will sustain both vertical

and lateral stress in the attachment to the second bicuspid will meet all requirements. (Fig. 254.) Each abutment then may move to a degree independent of the other while functioning. And if any advantage obtains from some increased mobility, it is obtained easily in this manner without diminishing the efficiency of the pontic.

Class 2.—Replacement of Missing First Bicuspids. The cantilever type of fixture also is useful in cases which involve several teeth of different functional activity. A movable joint between the cuspid and first bicuspid affords the advantage of permitting the abutments to move somewhat independently of each other in functioning. (Fig. 255.) This advantage never must obtain at the expense of strength and efficiency, however.

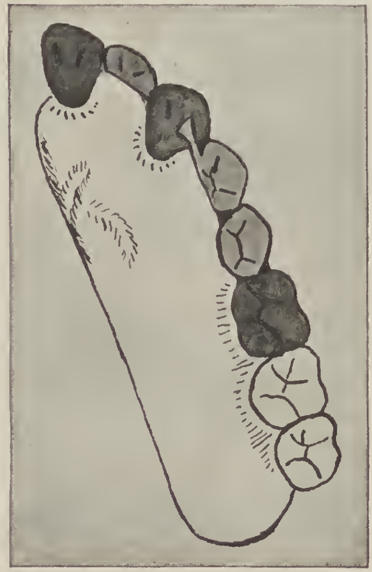


FIG. 255.

Interrupted Fixtures.

A type of construction, known as an "interrupted" fixture, is used sometimes in cases where a single good tooth remains intermediate to the teeth to be used as abutments and the pontics to be replaced, and where the number and distribution of the abutment teeth is favorable to the requirements, without using or in any manner involving the remaining tooth.

It is, of course, never advisable to use more teeth than necessary to

insure stability, efficiency and permanency. Hence, in cases of this type, there is a temptation to conserve all good teeth not actually needed in meeting the requirements, and to build the fixture around such teeth. This is accomplished by making the fixture in segments and joining, or uniting, the segments with heavy plate or wire. Round iridio-platinum, or clasp-metal wire, about 16 gage, is generally used for this purpose, and it is placed to the lingual of the remaining tooth, and just free from contact with it and the mucosa. (Fig. 256.)

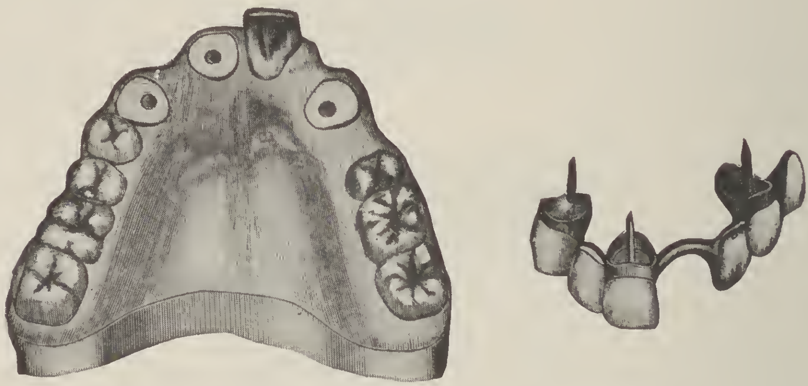


Fig. 256.

This type of construction presents two objectionable features: First, even though the wire is not in actual contact with the tooth, or with its surrounding tissues, such fixtures are not sanitary; and second, the wire is an impediment to speech, usually. Therefore, as a rule, it would be better either to build two separate fixtures, or to include and involve the intermediate tooth.

Extension Fixtures.

Previous to the application of fixed bridgework along the more modern and more rational lines now practiced, a type of construction known as "extension" bridgework was used. Fixtures of this type involved a saddle extending from the fixture proper, and resting upon the mucosa, as a means of supporting one or more suspended pontics. (Fig. 257.)

Because of the yielding character of the subjacent soft tissue as compared with the resistance offered by the abutment teeth, the entire burden of stress assumed by such extensions must be supported by the abutment teeth alone, and this burden is increased proportionately by the power of the lever.

Hence, irrespective of the number, distribution and original stability of the abutment teeth, all pontics supported by an extension, which is fixed at one end only, are not to be regarded as efficient restorations, nor is this type of fixture to be regarded as one which subscribes to the basic requirements of sanitation to an extent which would give it a place of usefulness among modern methods of procedure.

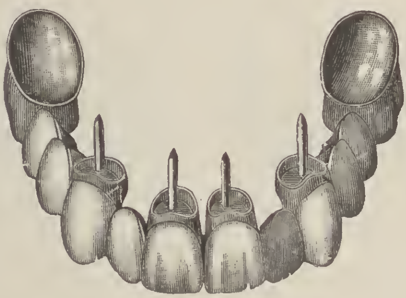


Fig. 257.

Saddle Fixtures.

A saddle resting firmly upon the subjacent mucosa and incorporated as a part of the structural formation of fixed bridgework was used more or less extensively at one time.

This type of construction was used as a means of increasing the structural strength of the fixture, and of effecting the restoration of lost tissue; and it was claimed that if the saddle is shaped properly and adapted closely the fixture will be sanitary; but no greater fallacy ever was promulgated.

When any form of saddle resting upon the subjacent mucosa is used in fixed bridgework, capillary stasis and congestion follow, and health and sanitation are impossible. Hence the use of a saddle of any form or size never is indicated and is not to be regarded as a rational procedure in the modern application of successful fixed bridgework.

Requirements. Primarily, fixed bridgework embraces an assemblage of attachments and pontics into one continuous fixture which is cemented to place upon its supporting abutment teeth. It therefore becomes a fixed part of the dental arch, and if the best results are to be obtained, the requirements are exacting and must be satisfied.

Adaptation. Adaptation, essentially, is the first requirement. Hence, the adaptation of all attachments to their supporting abutment teeth, and

of all pontics to the subjacent mucosa must be of such character as to preclude the possibility of mechanical irritation.

Strength. Since no fixture can be stronger than its weakest part, inherent strength adequate to meet the requirements of stress in each and every part of fixed bridgework of any type always must exist. Any deficiency in this direction only invites failure.

Attachments. As a means of conserving health by precluding the possibility of mechanical irritation, all attachments, whether they are full crowns, partial crowns, inlays or any variations of either, must be adapted closely. Accuracy of adaptation means absence of mechanical irritation, and absence of mechanical irritation means health, comfort and permanency.

Pontics. For esthetic reasons, all anterior pontics must be placed in close contact with the subjacent mucosa, but posterior pontics never should be placed in closer contact than the esthetic requirements demand; and as a means of providing further against mechanical irritation, the gingival edge of all pontics must be blunt, round and smooth. And all pontics should be of such shape and form, and should be placed in such relationship with the tissues and with each other, as to insure proper sanitation.

Hygiene and Sanitation. The problem of hygiene and sanitation is an important consideration in the replacement of missing teeth by any method. A failure to recognize and to appreciate the requirements in this connection has been a common practice and has been the cause of much criticism and condemnation of fixed bridgework. Generally, it has been justifiable.

That fixed bridgework may be a menace to health, and that a countless number of good teeth have been lost through misuse and abuse is unquestionable. Unsanitary conditions, in the main, are to be attributed to two general causes, however. First, to faulty adaptation of the attachments to the abutments; and second, to faulty structural formation.

Accuracy of adaptation is possible, and a type of structural formation favorable to sanitation is possible, also, but when an observation of these features, combined, is not possible, then fixed bridgework is not indicated.

Structural Formation. Anterior pontics, being of more favorable shape, usually are more susceptible of hygienic care than posterior pontics; hence, posterior pontics should be as nearly convex in form, bucco-lingually and mesio-distally as possible, and never should be larger bucco-lingually than the actual requirements of usefulness demand. This precaution will reduce inaccessible surfaces and will make it easier to ob-

serve hygienic care. Also, all interproximal spaces between the pontics themselves, and between pontics and attachments, must be sufficiently large to insure sanitation, and no form of saddle resting upon the subjacent mucosa ever should be used.

Instructions to Patients. If these requirements and precautions are observed carefully, and if the patient then is given proper instructions as

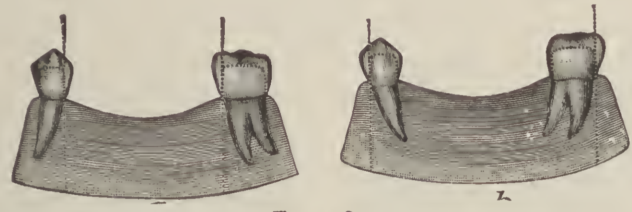


Fig. 258.

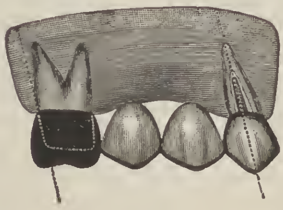


Fig. 259.

to the necessity for hygienic care, and is taught how it may be obtained, fixed bridgework may be kept as sanitary as the natural teeth themselves may be kept.

Paralleling Abutments. In the successful application of fixed bridgework, two or more teeth are to be linked or bound together with a single fixture. Hence, all abutment teeth must be prepared properly, not only as single unit abutments, but also along mutually parallel lines.

Parallelism of the axial surfaces of all abutment teeth, therefore, is an important and necessary consideration and must obtain in all cases and at all times. (Fig. 258.)

If parallelism does not obtain, accuracy of adaptation of attachments is impossible, and an unnecessary and often injurious strain is placed upon the roots of the abutment teeth. And, unduly forcing abutment teeth out of normal position invariably will invite a pathological condition.

When this requirement has been met properly, fixed bridgework will go to place readily, without appreciable effort and without strain. And

the requirements are the same in all cases irrespective of the type of attachment to be used, as illustrated typically in the use of a dowel crown and a telescope crown in a single fixture in Fig. 259.

Radiographic assistance always is essential and the use of a paralleling instrument, or even of simple calipers, will aid appreciably in meeting the demands of this requirement.

Articulation and Occlusion. The efficiency, comfort and permanency of fixed bridgework demand that the requirements of articulation and occlusion be met with exactness, and exactness demands accurate casts and

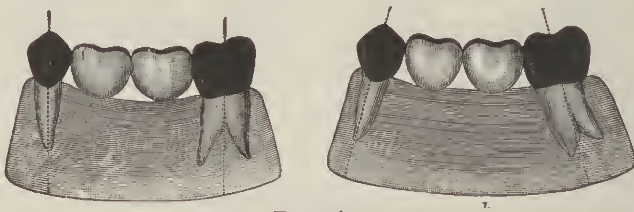


Fig. 260.

a careful study of the occlusion, in order that the pontics may be articulated so as to meet the requirements of functional occlusion when in use.

One of the commonest errors made in the construction of fixed bridgework is a failure to meet the requirements of stress in relation to the resistance offered by the abutment teeth. The direction in which the greatest and the least resistance is offered must be noted, and the occlusion so adjusted as to conform closely thereto.

In this connection it must be remembered that the abutment teeth will withstand vertical stress to the degree indicated, but that undue lateral, or antero-posterior stress lessens the stability, usefulness and permanency of the fixture which they support.

Therefore, the depth of the cusps and the adjustment of the relationship between the opposing teeth must provide for accommodation for the various excursions of the occlusal surfaces in functional occlusion.

If the long axes of the abutment teeth are along parallel lines, as illustrated in Fig. 260, any antero-posterior movement is mutual, and, hence, not especially injurious; but if the long axes of the abutment teeth are not parallel, one with the other, one will receive stress in line with its greatest resistance, and the other in line with its least resistance. In such cases the attachments should be adjusted to meet the requirements of each abutment tooth separately first, and the pontics then formed in such manner, and placed in such relationship with the opposing teeth as to permit the abutment teeth to assume the burden of stress at all times.

A proper formation of the cusps in such cases means that they should not be deep, and should not interdigitate appreciably, nor interlock to any degree; and also that they should be no wider bucco-lingually than absolutely necessary to provide some degree of usefulness.

Opening the Bite. Whenever the teeth in either arch are deprived of their normal relationship with the opposing teeth, elongation follows, is inevitable, and often results in an exasperating condition.

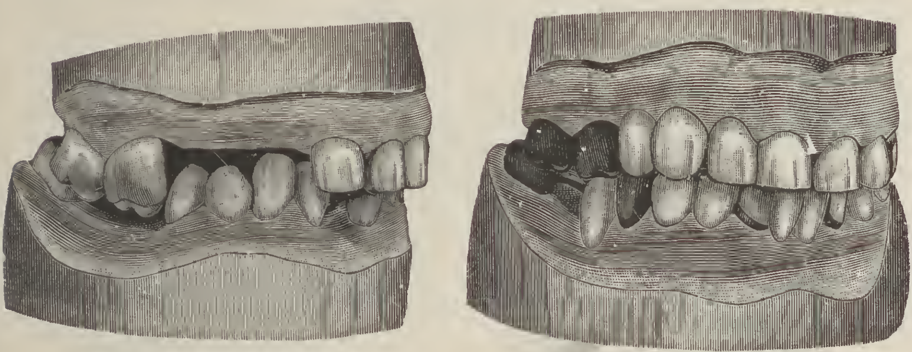


FIG. 261.

Elongation. This condition frequently demands correction, and correction often requires that the bite be opened, and that a new relationship between the opposing surfaces of the maxillary and mandibular teeth be established, before any type of useful restoration may be made.

When such conditions are encountered, accurate impressions and casts of all remaining teeth in both arches should be obtained and mounted upon an articulator. By careful study, the extent to which the bite should be opened then may be determined definitely. When the extent to which the bite should be opened has been determined, certain teeth upon each side of the arch which seem best adapted to the requirements incident to establishing the new closure, or relationship, should be selected.

The teeth selected then should be built up, or down, first as single units, by some means of permanent restoration. If the permanent restoration is to become a part of some type of fixed bridgework, the fixture should be completed and all restorations used in establishing the new relationship should be mounted at the same time. A typical case of elongation and the possibilities of restoration is illustrated in Fig. 261.

Grinding Natural Teeth. In cases of elongation, frequently it is advisable and often necessary to grind the occlusal, or the incisal surfaces

of elongated teeth. A reasonable amount of grinding is permissible wherever it may be indicated, provided that the surface ground is polished smooth after grinding.

In this connection, if the precaution of polishing smooth after grinding is observed carefully, the incisal ends of anterior teeth often may be ground until true and even without injury, and often to good advantage from the viewpoint of esthetics.

Fig. 262.

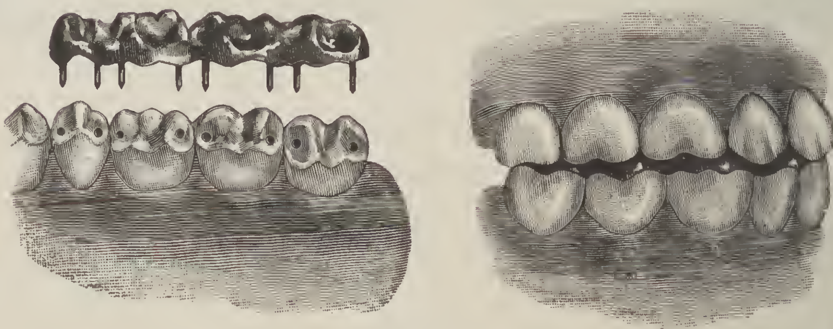


Fig. 263.

Wherever it may be necessary to grind the crowns of natural teeth to a point which leaves the dentin exposed to any great extent, the insertion of a simple filling may be indicated as a means of precluding caries.

Abrasion. Opening the bite is demanded frequently in cases of abrasion also. In such cases the desired relationship of the opposing teeth should be established first, by means of occlusal restorations, in the form of pin-locked inlays. These should be made for the teeth selected as single units first, after which they may be assembled, if assemblage is desired or necessary.

Occlusal restorations which are used for the purpose of opening the bite, whether used as single units, or assembled into one fixture, never

should be mounted finally until the new relationship is sustained by teeth on both sides of the arch, and by more than two teeth on each side, whenever possible.

The greater the number of opposing natural teeth which are involved in the initial procedure incident to the establishment of a new relationship, or to the restoration of the original relationship between the maxillæ and mandible, the less discomfort will be occasioned, and as some slight temporary discomfort follows opening the bite in nearly all cases, the preliminary precaution of using several teeth in the initial operation should be observed always.

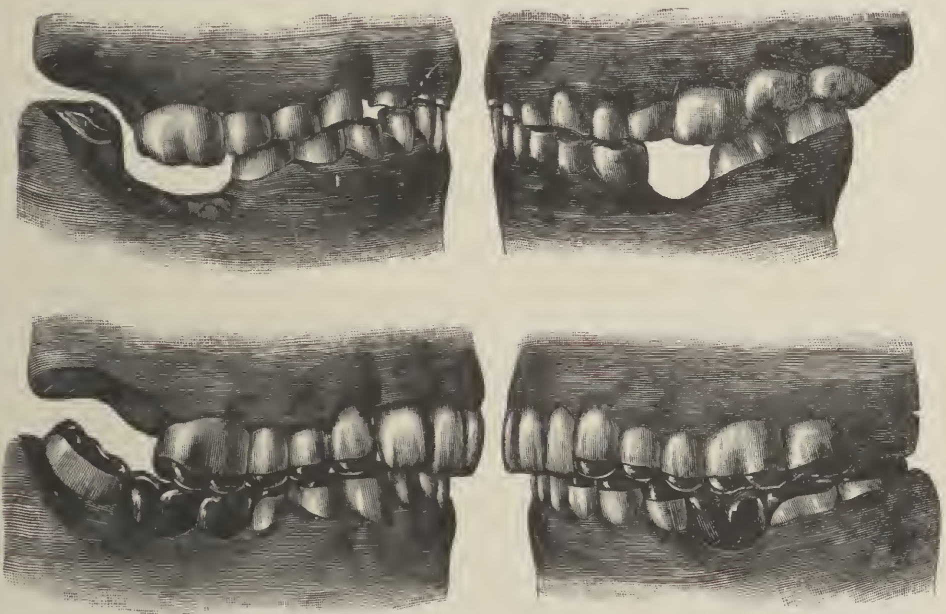


FIG. 264.

Iridio-platinum, or high-fusing clasp metal wire, 19 or 20 gage, is used for the pins in forming pin inlays. The inlays may be made either by the direct or the indirect method, and care must be exercised in placing and in drilling the holes in the natural teeth in order to avoid pulp exposure, and to insure parallelism.

A simple case of pin inlays used for the purpose of opening the bite in cases of abrasion is illustrated in Fig. 262, and a more extensive case in Fig. 263. The full possibilities in an extensive case of abrasion before and after opening the bite is illustrated in Fig. 264.

Construction.

The construction and application of fixed bridgework involves an assemblage of attachments and pontics. The attachments to the supporting natural teeth are the retaining agencies and, hence, they are essentially the vital factors in the success or failure of fixed bridgework of any type.

Attachments.

Since the advent and during the experimental and evolutionary stages of fixed bridgework, a myriad of methods of obtaining attachment to the natural teeth have been suggested and used, but only a few are recognized now as useful and reliable.

All methods of attachment necessarily involve some destruction of the supporting natural teeth, and hence the application of any method is largely a choice of evils.

In the selection of the particular method which seems best adapted to the case in hand, the essential features which should be considered, are as follows:

First: Which method will require the least destruction or mutilation of the supporting natural tooth.

Second: Which method will best aid in the maintenance of the health of the supporting teeth and their investing tissues.

Third: Which method will insure the greatest efficiency in the restoration of function.

Fourth: Which method will insure the greatest permanency in the restoration.

Fifth: Which method will be the least objectionable from the viewpoint of esthetics.

These considerations constitute the basic requirements for attachments for fixed bridgework and should govern the selection made for each and every case.

No two cases are alike in all of their details, and hence no one method is applicable universally. And when the selection of the method which seems best adapted to the case in hand has been made, then all of the requirements of adaptation must be met with the same care with which the selection itself was made.

The methods of attachment now in general use, and which afford the maximum range of application, may be classified as follows:

First: Full crown restorations.

Second: Partial crown restorations.

Third: Inlays.

Full Crown Restorations.

As attachments for fixed bridgework, full crown restorations of any type unquestionably comprise the most permanent method of procedure. While some simpler method often may offer assurance of several years of usefulness, and postpone final restoration by means of a full crown, thus adding to the aggregate longevity of the supporting tooth, still, the use of a full crown is indicated in many cases as the best means of obtaining a maximum of strength and of permanency in the initial restoration.

Dowel Crowns.

The use of dowel crowns as attachments for fixed bridgework is indicated whenever it may be warrantable to sacrifice all of the remaining natural crown to the gingival line, or whenever it may have been sacrificed to this point previously, and especially when any of the ten anterior teeth is involved.

Any of the various types of dowel crowns having a gold, or platinum coping may be used, and each crown should be made and finished as a single unit before the final grouping and assembling of the pontics. And when two or more dowel crowns are to be used in one fixture, parallelism of the dowels must be secured and provided for in the enlargement of the canals to receive them.

In the use of dowel crowns as attachments for bridgework, each and every crown must be made and finished as a single unit, first, irrespective of the size or relationship of the pontics to be supported by it. This is important and is necessary because the porcelain tooth or facing used must be placed *directly over* its supporting root in order to comply with the combined requirements of esthetics and sanitation.

Frequently, in cases where the supporting abutment root has moved or shifted mesially or distally, there is a temptation to place the porcelain tooth or facing to the mesial, or to the distal of the coping adapted to its supporting root, in order to make accommodation for the pontics to be supplied. But, unless the porcelain tooth or facing is placed immediately over its supporting root and in a direct line with its long axis, a shoulder is made by the offset, and whenever a shoulder is formed in this manner, it is formed at the expense of sanitation.

Use of All-Porcelain Teeth. In the use of all-porcelain teeth in the construction of dowel crowns which are to be used as attachments for bridgework, it is essential that the coping should present a surface of metal mesially, or distally, which will be adequate to the requirements of strength in the assemblage of the crown to the fixture.

This provision obtains in the use of the Goslee tooth, and with any of the all-porcelain crowns having detachable dowels, by grinding the mesial, or distal surfaces in such manner as to accommodate an extension of the coping which will afford opportunity for soldering in the final assemblage.

This mesial and distal extension of the coping must present toward the edentulous space on one or both sides in all cases, and must be sufficiently heavy to facilitate soldering and to insure strength in the final assemblage.

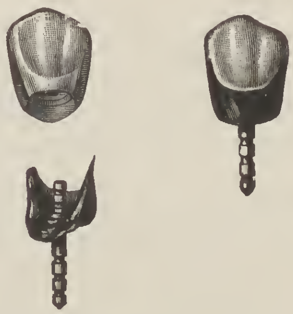


Fig. 265.

Fig. 266.

The requirements of construction of the coping in this connection and the typical application of the Goslee tooth is illustrated in Fig. 265.

When any other type of all-porcelain tooth is used, it may be ground in similar manner and to similar form, or it may be ground upon one surface only, as the requirements of soldering may demand, and as illustrated in Fig. 266.

Use of Porcelain Facings. In the use of dowel crowns with porcelain facings, the ideal type of construction, of course, embraces the use of replaceable facings, but whether replaceable facings are used or not, each crown should be made and finished to the point of polishing as a single unit. If replaceable facings are used, however, the facings never should be cemented to place until after the final assemblage of the entire fixture.

Telescope Crowns.

Full telescope crowns with or without a shoulder probably afford the most permanent means of restoration and attachment as applied to the molar teeth. Their use is more or less generally indicated whenever it is

warrantable to prepare the supporting natural tooth to the extent demanded for this type of crown. And when used as an attachment for bridgework, each crown should be made and finished as a single unit before the final grouping and assemblage of the fixture.

Partial Crown Attachments.

Notwithstanding the fact that full crown restorations probably offer opportunities for obtaining the maximum of permanency in the attachment of fixed bridgework, still, methods which require less destruction and mutilation of the supporting natural teeth, and which do not impinge upon nor involve the gingival tissues, present many advantages, and are indicated frequently.

The advantages to be obtained from the use of partial crown restorations are, primarily and manifestly, those of natural tooth conservation; and any method which will conserve the supporting natural tooth crown and pulp vitality, and at the same time insure permanency in the attachment, has a wide field of usefulness and should be used whenever the indications are favorable.

All methods of obtaining attachment to the crowns of remaining natural teeth may be grouped together and classified as partial crown attachments. These embrace many useful methods, but none susceptible to universal application. Therefore the selection of the one best adapted to the case at hand must be made with discriminating judgment, and with the conservation of the natural tooth crown and of pulp vitality as the dominating factor.

Partial Shoulder Crowns.

The partial shoulder crown, commonly called the "three-quarter" crown, is indicated and used only as an attachment for fixed bridgework. As applied to the six anterior teeth, it is the most difficult and yet the most ideal method of attachment now in use, and is indicated whenever teeth favorable to the requirements of the preparation present; whenever the required preparation can be attained, and whenever the adaptation may be made with accuracy and certainty.

The partial shoulder crown will appeal to all who are skilled craftsmen, but its application requires skill of a high order, combined with careful and precise technic, first, in the preparation of the supporting natural crown; second, in the construction of the attachment as a single unit; third, in transferring the work to the laboratory; and in the final assemblage of the fixture of which it is to become a part.

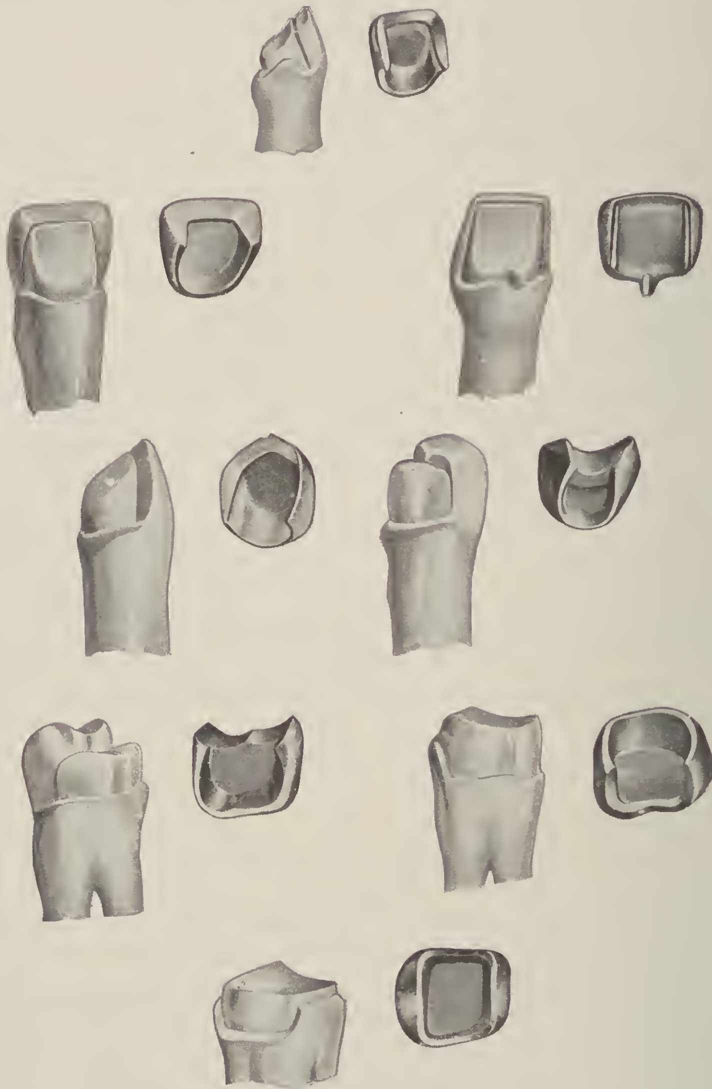


Fig. 267.

When a partial shoulder crown is used as an attachment, it may be made either by the direct or by the indirect method, as indicated previously, and it should always be made of a high fusing special alloy.

Also, parallelism with all other attachments must be obtained, and extreme care must be exercised in taking the final impression, in making the final cast, and in the assemblage of all parts with solder. It must be noted especially that the attachment is seated properly and securely in the impression, that it is sustained in position firmly on the cast, and that no change in its relationship may occur as a result of the shrinkage of solder in the final assemblage.

When all of these precautions have been taken, the partial shoulder crown has a wide field of usefulness as an attachment for fixed bridgework, but otherwise some simpler method is indicated. A series of partial shoulder crown attachments is illustrated in Fig. 267.

Groove Attachments.

A much simpler form of attachment may be designated as a simple groove attachment, though it is known both as the Carmichael and the Alexander attachment, and has been used more or less successfully for many years.

Anterior Teeth. In the application of this method of attachment to anterior teeth, a simple groove is cut into the center of the mesial and distal surfaces of the supporting natural crown, and the two lateral grooves then joined by cutting a groove through the lingual plate of enamel, as illustrated in Fig. 68.

Previous to cutting the grooves, the mesial and distal walls must be made to assume straight and parallel lines which is done with a thin vulcocarborundum disk. The mesial and distal grooves then should be cut, using small cylindrical stones first and finishing with a cross-cut fissure bur. The lingual groove then is made, using first a thin vulco-carborundum stone and finishing with a round bur.

The grooves are cut to a depth which would accommodate a round wire, about 17 or 18 gage. Pure gold, about 36 gage, then is adapted to these grooves, and to cover the entire lingual surface of the natural tooth crown.

This adaptation may be made by burnishing directly to the tooth, or by the indirect method. When the adaptation has been completed, the pure gold should be trimmed to the outlines desired, and then reinforced properly. The reinforcement may be made either by casting or by soldering.

Casting. If the casting method is used, the form and contour de-

sired should be made by building on the pure gold with casting wax; the sprue-former is then attached and the piece invested and cast, using a good clasp-metal alloy.

While this type of attachment might be made by the indirect method entirely, and without the use of pure gold as a matrix, still, the use of pure gold in the manner indicated, insures a better surface adaptation and diminishes the possibilities of any change of form which might be caused by shrinkage.

FIG. 268.

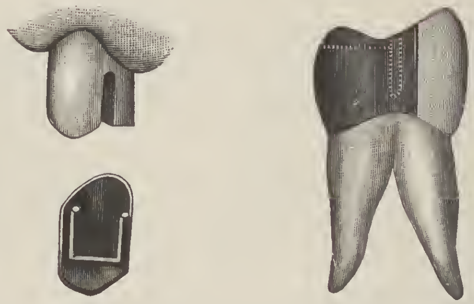


FIG. 269.

Soldering. If the reinforcement of the pure gold is to be made by soldering, it should be protected with base-plate wax and then removed carefully and invested properly for soldering. Clasp-metal wire, 17 or 18 gage, should be fitted into the groove carefully, bending one piece of wire to fill the groove completely. The reinforcement may be made with a high-grade solder. Small pieces of clasp-metal plate may be placed here and there to impart additional strength and resilience to the finished attachment. (Fig. 268.) When the attachment has been completed by either method it should be finished to the point of polishing and then adapted finally to its supporting tooth.

On account of the more favorable shape of the crowns of the cuspid teeth, this method of attachment is more generally useful when applied to these particular teeth, but it is applicable also to bicuspids.

Posterior Teeth. In the application of a simple groove attachment to bicuspid teeth, the lingual cusp must be sacrificed to accommodate a restoration of sufficient occlusal thickness to insure strength; and the mesial, distal and lingual surfaces must be reduced to an extent which will admit of a close adaptation at the gingival line. The grooves then should be cut as illustrated in Fig. 69, and the attachment made in the manner described. Because of the difficulty of burnishing even 36 gage pure

A B C

FIG. 270.

gold directly to the tooth, the best results are secured by the use of the indirect method. A good unit impression, and a good amalgam cast will insure a good adaptation, but the use of a matrix of pure gold, previously adapted to the amalgam cast by burnishing, is necessary and advantageous for the reasons mentioned. The completed attachment is illustrated in Fig. 269.

Pin Attachments.

A simple pin attachment involving only the lingual surface of the supporting tooth is used frequently in obtaining attachment to the six anterior teeth, only.

Vital Pulps. In the application of this simple method of attachment to the upper anterior teeth having vital pulps, the lingual surface of the natural tooth crown is first ground sufficiently to admit of the presence of a protecting plate of gold. Two holes, having a diameter proportionate with the size of the tooth, and as deep as possible without endangering pulp vitality, are drilled into the body of the natural crown, and toward the mesial and distal angles, as illustrated in Fig. 270 A and B.

In central incisors and cuspids, iridio-platinum, or clasp-metal wire, 18 to 20 gage, should be used for pins and the holes should be drilled with

a spear drill or round bur of the same diameter. In lateral incisors, a smaller wire, of course, must be used.

When the holes have been drilled and the pins fitted, pure gold, about 36 gage, should be adapted closely to the entire lingual surface of the natural tooth crown by burnishing. When the adaptation has been com-

Fig. 271.

pleted, the pure gold should be perforated over the holes, and the pins adjusted to place through the perforations, allowing a surplus of about two millimeters to project.

The relationship of pins and pure gold (Fig. 270 C) now should be sustained with adhesive wax and the piece then removed, invested, soldered and reinforced heavily, using 22 or 20 karat solder. The pure gold is used as a support and protection to the pins, and to the mounting medium after mounting, and for the purpose of affording a soldering surface adequate to the requirements in the final assemblage of the fixture. Therefore, it should be as heavy as occlusion will permit, in order that it may not change form under the influence of stress.

The surplus ends of the pins never should be cut off until the final assemblage of the fixture has been completed for the reason that they facilitate the removal of the attachment with the impression, and insure the correct relationship of the attachment in the impression.

In the application of this attachment to lower incisors, where it is par-

ticularly useful, the holes necessarily must be smaller, and should be placed well toward the incisal end in order to minimize the danger of pulp involvement. In these teeth the pins should be made of 20 to 22 gage wire, usually. A typical application of this type of attachment to the lower incisors is illustrated in Fig. 271.

Open-Face Crowns.

The type of partial crown known as an open-face crown has been used as an attachment for fixed bridgework for many years, with varying degrees of success and failure.

FIG. 272.

A minimum of destruction of the supporting natural crown, and simplicity of construction, which are always desirable features, constitute the chief advantages obtainable from the application of this type of attachment. These advantages cause it to have a limited field of usefulness.

Anterior Teeth. Open-face crowns are applicable to the anterior teeth mainly, and to the cuspid teeth in particular. Because of the normal shape of the crowns of the cuspid teeth, less preparation is required in obtaining adaptation than is required for any other type of attachment. The natural shape of the crowns of the lower incisors also is more or less favorable for this type of attachment, but the more exaggerated bell shape of the crowns of the upper incisors demands such extensive preparation upon their mesial and distal surfaces as to contraindicate the use of an open-face crown in practically all cases.

And even when the application is made to the crowns of teeth which are of favorable shape, and where but little destruction or mutilation is required, this method of attachment does not subscribe to the esthetic requirements, and is objectionable for this reason.

However, when this objectionable feature may be waived, or may be the lesser evil, and when a maximum conservation of the natural tooth crown is desired, the use of an open-face crown affords opportunity for a secure and more or less permanent attachment for fixed bridgework.

And as an attachment it will be successful and permanent in proportion as it may be well adapted and offer no degree of gingival irritation. This latter feature is a most important consideration at all times.

The requirements of preparation have been illustrated previously in Figs. 70 and 71, and the requirements of construction in Fig. 120.

Posterior Teeth. Simple open-face crowns also are applicable to the posterior teeth, and their use may be indicated upon these teeth in occasional instances. In their application to bicuspids and molars, the lingual cusps should be sacrificed as indicated previously for groove attachments, and the mesial, distal and lingual surfaces of the natural tooth crown must be reduced to an extent which will admit of an adaptation at the gingival line.

Fig. 273.

In many instances, however, an adequate attachment may be obtained without permitting the peripheral band to approach closely to the gingival tissues. Whenever this feature is obtainable with opportunity for sanitation and with reasonable assurance of integrity in the attachment to the supporting tooth, a free exposure of the tooth at the gingival line is a desirable feature. (Fig. 272.)

Partial Telescope Crowns.

Partial telescope crowns which do not involve contact with the gingival tissues are useful as attachments in many cases, and particularly where the supporting natural crown is of considerable length occluso-gingivally.

In such cases, attachments of this type may be made to include and involve only the occlusal two-thirds of the crown of the supporting natural tooth, thus avoiding any impingement upon or contact with the gingival tissues.

Whenever adequate strength in the attachment to the supporting abutment is insured, this type of partial crown possess a distinct advantage over a full telescope crown, and is a useful attachment for fixed bridgework.

Partial crowns of this type may be made with a band and a swaged or cast occlusal surface, or by the indirect method and casting, as described previously in connection with full telescope crown restorations. In the use of this type of attachment, the mesio-gingival, or disto-gingival edge of the telescoping band must be carried to a point where it will be free from contact with the adjacent natural tooth crown, or the pontic, or both, as illustrated in Fig. 273.

Inlays.

Inlays of some form may afford attachment for all types of fixed bridgework. With the advent of the cast inlay it was thought that the possibilities of adaptation insured a successful means of attachment to the remaining crowns of supporting natural teeth in all classes of cases, and for all types of bridgework, and simple inlays were used indiscriminately, but with disastrous results in many instances.

With the increasing demands of prophylaxis, any effort to conserve natural tooth structure and to make restorations, or to obtain attachment for bridgework without impinging upon the gingival tissues, or otherwise disturbing the normal conditions, is highly commendable. Inlays subscribe to the requirements in these desirable features, but when used as attachments for bridgework, they must subscribe also to other requirements if success is to be insured.

A simple inlay, irrespective of how well it may fit the supporting cavity walls and margins, and of how well it may restore the supporting tooth as a single unit restoration, is not always a reliable attachment in bridgework. But when all requirements are observed, inlays of some form have a wide range of application and a broad field of usefulness.

In the use of inlays as attachments for bridgework, it must be recognized that the inlay must be adapted to the supporting tooth in such manner as to resist the influence of stress in all directions, and the influence of torsion, in particular. Primarily, resistance to stress demands: First, that the supporting cavity be prepared properly; second, that the inlay be seated firmly in the cavity; and, third, that it be locked mechanically in its relation to the supporting tooth.

The requirements of cavity preparation are based upon extension for prevention in all cases, and demand an observation of the following general rules:

First: The cavity should be formed with a square, flat base.

Second: No weak and unsupported walls should present.

Third: The axial margins should be slightly diverging and beveled sufficiently to protect the enamel rods.

Fourth: All deep pits and fissures should be included in the cavity formation.

Fig. 274.

Fig. 275.

Fifth: All axial margins must be extended beyond any possible contact with adjacent natural teeth or pontics.

Sixth: The linguo-axial margin presenting toward the edentulous space must be extended sufficiently to afford a free exposure of the inlay in order to facilitate soldering and to insure strength.

Anterior Teeth. In the use of inlays as attachments to the anterior teeth, but two general forms of cavity preparation are adopted generally. One involves the lingual and both mesial and distal surfaces of the supporting tooth, and is practically the same as described in connection with partial crown restorations. (Fig. 274.) The other involves the lingual and mesial or distal surfaces only, as illustrated in Fig. 275.

Where the lingual and both mesial and distal surfaces are involved, the use of pins is not necessary, but where the lingual and mesial or distal surfaces only is involved, the use of one or two pins is usually necessary.

In making inlays of the former type where no pins are used, either the direct or the indirect method may be used successfully.

Posterior Teeth. In the use of inlays as attachments to the posterior teeth, the conditions vary to such an extent that it is almost impossible to follow any one typical outline, provided that the general rules governing cavity formation are observed. A series of typical cavity formations and inlays are illustrated in Fig. 276. In simple inlays either the direct or the indirect method may be used successfully.

Fig. 276.

Use of Pins. Whenever there is any doubt as to the possibility of a secure attachment of an inlay to its supporting natural tooth crown, where it is to serve as an attachment for bridgework, often one, or more, pins must be used as a supplementary means of insuring stability and positive fixation.

Teeth with Vital Pulps. In teeth having vital pulps, one, two, and sometimes three small pins may be used to good advantage, and are frequently necessary.

In drilling holes for the reception of pins, it is important to place the holes at points which will insure stability, and yet will not endanger pulp vitality. A spear drill, or round bur, of the same size as the wire of which the pins are made should be used, and it is important that the holes should be drilled along parallel lines.

Pins which are to become an integral part of the inlay should be made of round iridio-platinum, or clasp-metal wire, 20 to 22 gage, and, in the use of pins, the best results are obtained by the use of a matrix made of pure gold, about 36 gage, and adapted previously by burnishing or swaging, which may be done either by the direct or the indirect method.

Use of Matrix. The use of a matrix insures the proper relationship of the pins to the holes and with each other. When the cavity formation has been completed, the holes drilled, the pins fitted, and the matrix adapted satisfactorily, the matrix should be perforated over each hole. Each pin then should be forced through the perforation and to the full depth of the hole, allowing a surplus of about two millimeters to project.

The relationship between matrix and pins now should be sustained with adhesive wax, then removed, invested, and each pin soldered to the matrix with a very small bit of high grade solder. Matrix and pins now should be replaced in position on the supporting tooth and finally trimmed and burnished. The desired restoration of contour then may be made by casting, or with solder, in the manner described previously.

Without Matrix. In cases where only one, or perhaps two pins are to be used, a matrix may not be necessary. In such cases the surplus ends of the pins should be bent at right angles and the wax pattern then made directly in the cavity with the pins in position, and the casting made subsequently.

Where no matrix is used, and where the wax pattern is adapted by the direct method, it is important to observe that the pins are engaged in, or attached securely to the wax pattern before the investment and casting are made.

A typical preparation for bicuspid teeth in which only one pin is used in this manner, and for molar teeth in which two pins are used is illustrated in Fig. 67.

Separable Pins. In posterior teeth having vital pulps where the use of a pin may be desirable, and yet where some danger of pulp complications present, inlays having a separable pin which may be placed at any angle are sometimes useful.

Separable single pins which may be inserted through the inlay and at a tangent with each other when two are used in the same fixture, and which may be placed at the time of the final mounting of the fixture, may be made by drilling the hole into the tooth at the desired point, first, to the required depth, and at any angle which will insure adequate strength with freedom from pulp complications.

A pin of proper size and length then should be fitted into the hole

allowing a liberal surplus to project. The wax pattern then should be made over and around the projecting end of the pin and when formed and contoured to the desired outlines, it should be teased gently until it may be removed from the cavity. The pin then should be warmed slightly

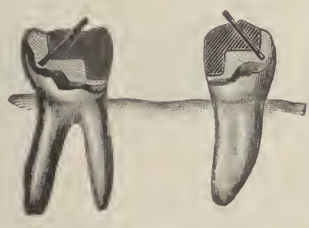


Fig. 277.

Fig. 278.

Fig. 279.

Fig. 280.

Fig. 281.

by grasping the surplus end with warm pliers, detached from the wax pattern, and a carbon point of the same diameter as the pin, then introduced into the opening. Inlay and carbon point now should be replaced in the cavity and the carbon point sealed to the wax pattern. (Fig. 277.) When removed, both ends of the carbon point should be exposed freely, as illustrated in Fig. 278. The pattern then should be invested and cast, after which the carbon may be removed by boiling in dilute hydrochloric acid. The inlays then should be finished (Fig. 279) and the fixture built independent of the pins.

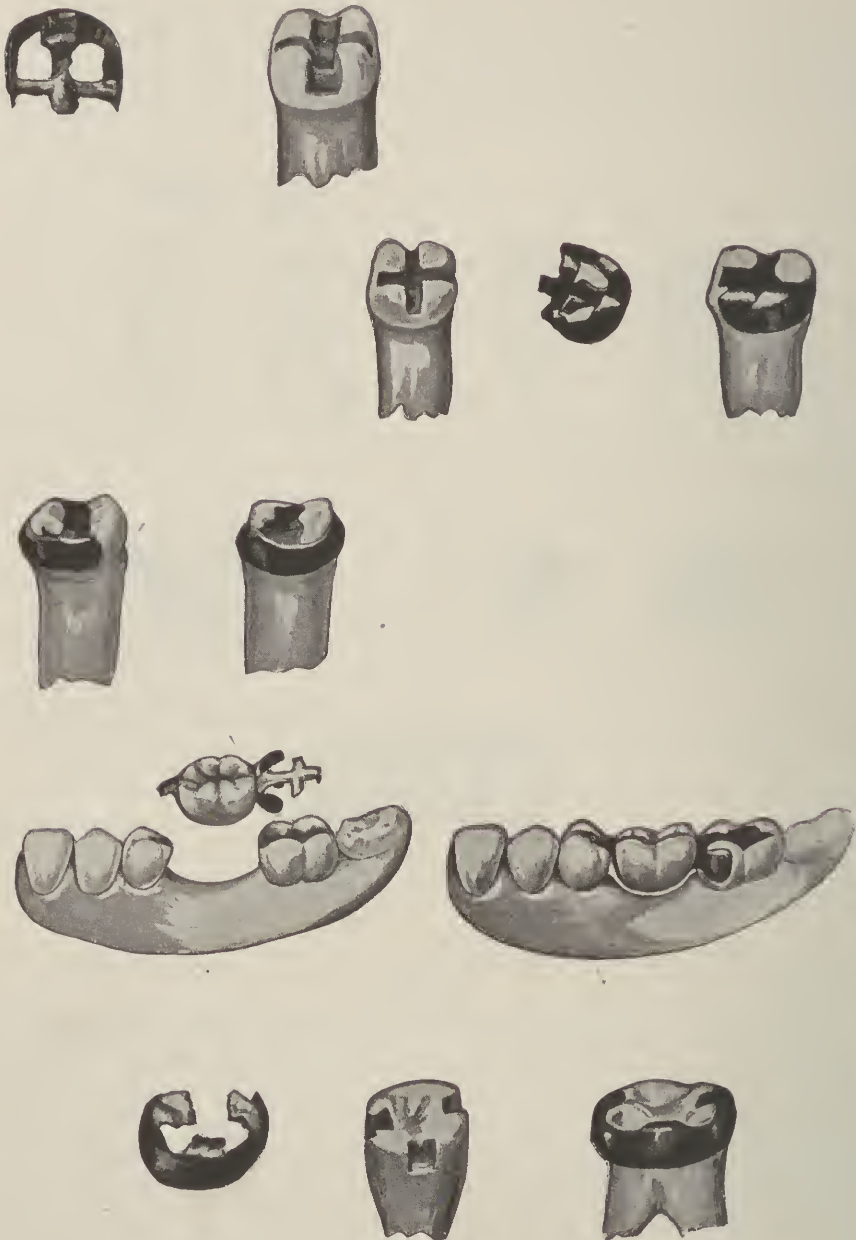


Fig. 282.

When completed, the fixture and pins should be mounted at the same time. The completed fixture, with the separable pins in place before mounting, is illustrated in Fig. 280, and the result after mounting and after removing the surplus ends of the pins, is illustrated in Fig. 281.

Inlay in Combination with Partial Peripheral Band.

One of the simplest and most useful methods of attachment to posterior teeth involves an inlay in combination with a partial peripheral band, made all in one piece by the indirect method and the casting process, as suggested by Dr. R. E. MacBoyle.

As a means of circumventing the use of pins in inlay attachments, and of obtaining a maximum of strength in the fixation of the attachment to its supporting tooth with a minimum of tooth destruction, and as a means of avoiding any impingement upon, or contact with the gingival tissues, and of affording every opportunity for soldering the attachment to the fixture, this type of attachment is useful.

Because of involving and including a partial peripheral band adapted to the largest circumference of the supporting natural tooth crown, the use of pins is unnecessary, less extensive cavity preparation is required and the indirect method is used exclusively, as described previously.

The requirements of preparation consist, first, in reducing the convexity of the mesial or distal axial wall adjacent to the edentulous space, and then forming a cavity of typically retentive outlines. The peripheral band must involve only the largest circumference of the axial walls embraced, and usually need not embrace more than half of the circumference of the supporting natural tooth crown.

A series of typical attachments of this type are illustrated in Fig. 282.

Pin Inlay Attachments.

A combination of pin and inlay attachments both for anterior and posterior teeth, which embrace a distinctive and more or less ideal type of preparation, has been suggested and is used extensively and successfully by Dr. James Kendall Burgess.

Anterior Attachments. The preparation required for attachments to the anterior teeth consists in making three or four steps in the lingual surface of the natural tooth crown, and making each step of dimensions large enough to form a seat with a flat base and square shoulder, and large enough to accommodate a hole for the reception of a pin, as illustrated in Fig. 283.

Posterior Attachments. The preparation required for attachments to the posterior teeth consists first in reducing the convexity of the mesial or distal axial wall adjacent to the edentulous space, and then forming a cavity not deeply, but of typical retentive outlines. Holes then are drilled for the reception of pins.

A matrix is made of 36 gage, pure gold, in the adaptation of which either the direct, or the indirect, method may be used. When the matrix

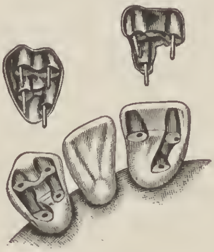


Fig. 283.

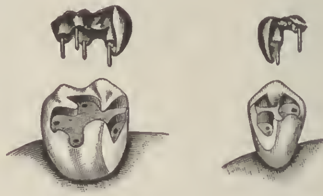


Fig. 284.

is adapted properly and trimmed to the desired outlines, perforations are made over each hole, and the pins are carried to place through the perforations. The relationship is sustained with adhesive wax, and the matrix and pins are removed, invested, and the pins attached to the matrix with solder. The pin inlay then may be completed by investing and building the contour with 22 karat solder, or by casting. The typical preparation, together with completed attachments, are illustrated in Fig. 284.

This type of attachment is useful also for stabilizing loose teeth.

Stabilizing Loose Teeth.

Attention has been directed previously to the advantages obtainable by stabilizing loose teeth. In many cases this procedure is indicated and offers possibilities for adding to the comfort, usefulness and retention of teeth for many years. Stabilizing loosened teeth will not remove a pathological condition, but where no lesion exists, or where existing lesions may be cleared up, fixation puts the teeth to rest and gives Nature a chance to build up and restore.

The stabilizing of loosened teeth may be accomplished by two methods of procedure: First, by simple bands made and adapted first as single units and then assembled into one continuous fixture and cemented to place; and, second, by a series of pin-locked inlays made also as single units, and then assembled into one fixture and mounted.

When simple bands are used, they should be made narrow upon the

labial surface, and wide upon the lingual surface, in order to avoid any unnecessary or objectionable display of metal. Iridio-platinum, or 22 karat gold plate, 32 gage, is used for this purpose. The bands should be made first and fitted carefully to each tooth to be involved in the fixation, then placed in position on the teeth and an impression in plaster obtained.

Fig. 285.

Fig. 286.

After removing the impression, it should be noted that each band is in its proper position, after which the impression should be varnished and filled with soldering investment compound which crystallizes. Pressing the point of an ordinary pin firmly into the center of the imprint of each tooth and band in the impression before pouring the cast will insure strength in the cast. The bands then should be assembled, using only a sufficient quantity of solder to insure strength, and when assembled properly, the fixture should be finished, polished and mounted.

The use of pin-locked inlays requires the drilling of two small holes in the lingual surface of each tooth to be included in the final fixation. These holes should be of the size of 19 or 20 gage round wire, and, in anterior teeth, should be placed well toward the incisal end, and well toward the mesial and distal angles, both of anterior and posterior teeth, in order to avoid pulp complications.

While drilling the holes and otherwise preparing the natural teeth, they may be stabilized temporarily by previously molding impression compound to their labial and buccal surfaces, and tying it to place with ligatures as illustrated in Fig. 285.

When the holes are drilled, each inlay should be made separately, using a matrix of pure gold, 36 gage. The matrix may be made either by the direct or the indirect method.

When each inlay has been made as a single unit, all should be placed in position on the teeth and an impression taken in plaster. The same precautions indicated previously for simple bands should be taken in obtaining the cast. The inlays then should be assembled into one fixture with a high-grade solder, and subsequently finished and polished.

The finished result, showing large interproximal spaces, and the absence of any cause for gingival irritation, is illustrated in Fig. 286.

Fig. 287.

Pulpless Teeth.

In the use of inlays as attachments for bridgework, in pulpless teeth, one strong dowel of a size proportionate with the size of the tooth involved, will meet the requirements in all teeth having but one root canal. In multi-rooted teeth two dowels may be used if necessary, but care should be taken not to weaken the supporting natural crown unnecessarily.

Even in multi-rooted teeth one dowel will be sufficient usually, and this should be placed always in the largest canal. When one dowel only is used, a matrix rarely ever is indicated, and the best results are obtained by making the inlay by the direct method and casting to the dowel. As a means of insuring accuracy, the surplus end of the dowel should be retained in all flat-surface inlays until after the final assemblage of the fixture.

Temporary Attachments.

Fixed bridgework may be indicated at times in cases where any preparation of the crowns of the supporting natural teeth either is inadvisable or impossible.

Cases of this character often present in the mouths of young patients,

where the replacement of missing teeth is essential to the correction of malocclusion, and where any immediate or appreciable destruction of the crowns of natural teeth is inadvisable; and in cases of advanced age, frequently, any preparation of the natural crowns of teeth might be inadvisable or unnecessary because of the physical condition of the patient.

In such cases, some simple form of attachment might be indicated in preference to any procedure which would involve some destruction and mutilation of the crowns of natural teeth.

Fig. 288.

Simple bands made of 22 karat gold plate, or of platinum, 32 gage, made in the usual manner and fitted closely to the largest circumference of the natural tooth crown, without any preparation whatever, often will serve a useful purpose in these cases.

In obtaining attachment to the anterior teeth, the band should be as narrow as possible upon the labial surface, but wide enough upon the lingual surface to insure stability and to prevent displacement, as illustrated in Fig. 287.

Attachments to the posterior teeth should be adapted in similar manner, but should be provided with an occlusal extension, resting into the mesial and distal embrasures, as a means of precluding displacement. (Fig. 288.)

Lingual Supports.

In the construction of small anterior fixtures, where one tooth is suspended anterior to its abutment, some provision against the rotation of the abutment tooth on its long axis, and the resulting displacement of the suspended pontic, always must be provided. What is called a "lingual support" is used for this purpose.

A lingual support may or may not be sanitary, and may or may not do

injury to the natural tooth crown against which it rests. Both depend entirely upon its adaptation.

In the use of lingual supports the following basic features must be observed:

First: The support must be sufficiently strong to withstand the stress imposed upon it.

Second: It must be in direct contact with the adjacent natural crown at its extreme end only.

Fig. 289.

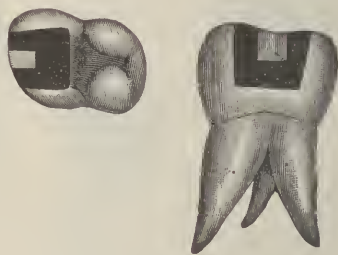


Fig. 290.

Third: It must not impinge upon the gingival tissue.

Fourth: It must not interfere with the opposing teeth.

If these requirements are met carefully, lingual supports may be sanitary, and will do no serious injury to the natural crown against which they are placed.

Round iridio-platinum, or clasp-metal wire, about 16 or 17 gage should be used, and the adjustment can be made best after the case has been invested, and just previous to heating and soldering. The requirements of adaptation are illustrated in Fig. 289.

Occlusal Rests.

In the replacement of one, or sometimes two, posterior teeth, the cantilever type of fixture which involves positive fixation at one end, and a simple rest into a filling at the other end, is used frequently, and has some advantages. The advantages obtaining consist mainly in permitting each abutment tooth to move more or less independently of the other in functioning.

A simple projection, extending from the fixed part of the structure and resting into an inlay restoration, in or near the occlusal surface of the adjacent abutment tooth, provides a flexible or movable joint at this

end of the fixture, and yet offers adequate support against both vertical and lateral stress. These projections are known as "occlusal rests."

In the construction of inlay restorations which provide for an occlusal rest, the inlay should be made and finished as a single unit first. A seat having a flat, square base, with slightly flaring axial walls, then should be cut into the center of the occlusal surface extending toward the gingival margin as illustrated in Fig. 290. The dimensions of this seat should be such as to accommodate freely, round or square iridio-platinum, or clasp-metal wire, about 16 gage. When the seat has been prepared in

FIG. 291.

this manner a matrix of pure gold, about 36 gage, should be burnished well into the seat, allowing a slight surplus to overlap upon all margins. A piece of wire as indicated should be cut of proper length and fitted into the pure gold matrix. The relationship should be sustained with adhesive wax, and matrix and wire then invested and united with 22 or 20 karat solder, using sufficient solder to make all surfaces smooth and continuous. When soldered and finished a well adapted occlusal rest obtains. A surplus projection of the wire always should present as a means of insuring proper relationship and adequate strength in the final attachment of the occlusal rest to the fixture.

Occlusal rests, made in this manner, should be finished and polished finally, after the fixture is mounted, and will fit so closely as to be more or less sanitary. A typical application has been illustrated previously in Fig. 254.

Another method of providing an occlusal rest is to drill a simple, round hole of suitable dimensions in the wax inlay pattern just previous to investing and casting and at a point not involving any of the margins. This may be done with a spear drill or round bur. When the inlay has been cast and finished the hole should be reamed out smooth and the end of a piece of iridio-platinum, or clasp-metal, wire fitted into it carefully. The surplus end of the wire then should be bent to close contact with the axial wall of the inlay so as to offer opportunity for attachment to the

fixture and without interfering with the correct placement of the adjacent pontic. When the fixture is completed and finally polished, fixture and inlay restoration are placed in their correct relationship and mounted at the same time. (Fig. 291.)

Pontics.

"Pontic" is the name given to an artificial tooth used as a substitute for a missing natural tooth in the construction of dental bridgework.

To the patient pontics play a most important rôle. And, if missing natural teeth could be replaced successfully without abutments and without attachments, esthetics often would be the chief, if not the only requirement demanded.

But, in the art of replacing missing teeth in all except edentulous cases, to the dental craftsman the abutments are the foundation, the attachments are the keystone, and the pontics are the superstructure only.

And, yet, even though the pontics are third in the order of construction, they, too, must subscribe to all requirements of usefulness, sanitation and permanency, as well as to the requirements of esthetics in particular.

The basic requirements of pontics, therefore, are manifold: First, they must restore function; second, they must be of such form and shape as to insure sanitation; and, third, they must meet all demands of esthetics. Hence, the selection of the type of pontic which will be or which is best adapted to all requirements of the case in hand is an important consideration in the construction and application of dental bridgework, and no one type is applicable universally.

Selection of Type. Previous to the selection of the type of pontic best adapted to the requirements, each attachment should be finished to the point of polishing, as a single and separate unit. The finished attachments then should be placed in position upon their supporting teeth and an accurate bite and an accurate impression secured.

Bite. The bite should be taken in base-plate wax previous to taking the impression, and care must be observed to obtain the normal occluding relationship of the opposing natural teeth.

When taking the bite it is absolutely essential to observe that the jaws are closed in *centric* occlusion. This procedure is not easily controlled because there is always a pronounced tendency to move the mandible forward or laterally, or to close into some position of eccentric occlusion when biting through wax, or when resistance is offered.

Impression. When the bite has been taken as indicated, it should be observed again that all attachments still remain in their proper relationship

with the supporting abutments and the impression then should be taken in plaster. Except in very small cases, the final impression should include all remaining natural teeth in the arch. After removing the impression, all attachments should be seated firmly in their correct position therein and the impression then varnished.

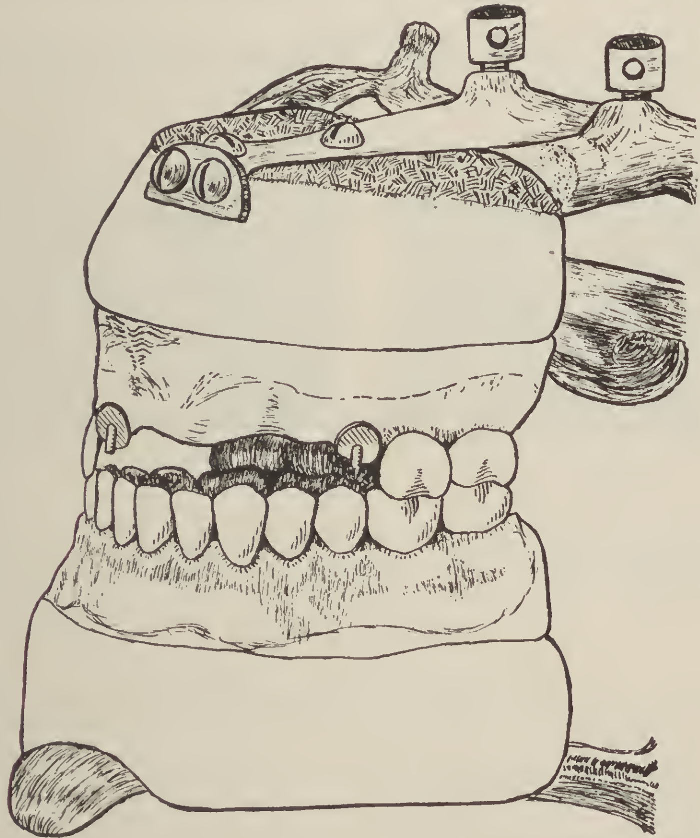


Fig. 292.

Any attachments which are to be detached from the cast during the construction of the fixture, should be painted with melted wax previous to pouring the cast. This precaution will facilitate their detachment, but should be taken only when detachment is necessary.

Attachments never should be detached from the final cast, however, unless absolutely necessary, and when they are not to be detached it must be observed that they are filled completely in pouring the cast.

Cast. The cast should be made of a high-grade soldering investment compound which crystallizes, is of a dense, smooth texture, and which does not shrink nor expand appreciably during or after crystallization.

When the cast has been obtained, the bite should be adjusted carefully, and the case then mounted upon an articulator as illustrated in Fig. 292.

The selection and the correct adjustment of pontics can be made properly only after the case has been mounted upon the articulator. And,

Fig. 293.

except in very small cases, the use of some form of anatomical articulator is advantageous.

Anterior Pontics.

In the replacement of missing anterior teeth three different types of pontics are used. These embrace: First, replaceable porcelain facings; second, replaceable all-porcelain teeth; and, third, flat-back facings with platinum, or platinum alloy pins.

Median Line. In the selection of anterior pontics involving the replacement of central incisors, the median line must be preserved at all times and under all conditions. Any deviation from the median line will destroy completely all esthetic possibilities. (Fig. 293.) Therefore, it must be established definitely and positively.

Width. With the median line as a guide, the pontics must be of such width as will be required to fill the edentulous space with the proper number of pontics. And they must be of proportionate and uniform size and the same on each lateral side of the arch.

The width of the pontics, therefore, is governed entirely by the number of pontics required to fill the edentulous space on each lateral side of the arch, from the median line to each lateral abutment, and, irrespective of the distribution of the abutments, each lateral side must correspond. Uniformity and symmetry must obtain always if a high order of esthetics is to be achieved.

Length. In order to conform to the requirements of esthetics, whenever possible, the pontics should be of the same length as the crowns of any remaining natural anterior teeth. Also, they should be of a length which will permit the gingival edge to rest firmly upon the mucosa, and the incisal ends to correspond with the length of the crowns of the remaining natural teeth.

In the replacement of all six anterior teeth, where there is no other guide, the lip line and the requirements of occlusion will govern the length, and the normal arc of the circle should be restored always.

Color. The highest possibilities in esthetics demand always that the color of the remaining natural teeth be simulated closely. Whenever a more or less perfect match in color is impossible, a shade darker, rather than one lighter, should be selected, and when several teeth are used in the same case, some slight variation in color often is advantageous.

In the use of porcelain facings of any type, the translucency of the porcelain is destroyed by the presence of metal backings. Hence, the facings are always a shade darker after being attached permanently by cementation, or by soldering, and an allowance for this change must be made at the time of making the selection.

Replaceable Facings.

Replaceable porcelain facings are the most generally applicable and, therefore, the most useful type of pontic for the replacement of missing anterior teeth. Several different designs have been suggested and manufactured, but the type known as Steele's Interchangeable Facings of the "Trubite" mold are used, practically to the exclusion of all others.

Special backings are made in gold alloy and in a base-metal alloy for each size of facing. While either will withstand casting, or will withstand a high-grade solder, still, those made of gold alloy are more reliable and should be used always.

The backings should be obtained at the time the facings are selected, and the selection of duplicate facings at the same time also is always advisable.

When the selection has been made, each facing should be ground first to the desired and required adaptation to the cast, and with each other. The backings for each facing then should be fitted. The gingival and mesial and distal edges of the backings should be finished flush and smooth with the facings, but a slight surplus should be allowed to remain at the incisal edge, as illustrated previously in Fig. 159 C. This affords opportunity for a better protection of the porcelain facing after cementation.

Whenever the requirements of occlusion will admit of reinforcement, some reinforcement of the incisal ends of each backing as a single unit should be made. This may be accomplished by attaching a piece of

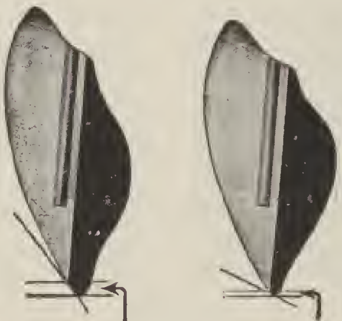


Fig. 294 A.

clasp-metal, or 22 karat plate, 28 or 30 gage, with solder, previous to the final assemblage. (Fig. 159 E.) The completed pontic showing the protection of the incisal end is illustrated in Fig. 294 A.

And where several backings are to be assembled in one fixture, they should be assembled previously, in sections of two or three. By this means the final assemblage of facings and backings upon the cast previous to investing and soldering is facilitated; and because of the advantage obtainable from the use of a minimum of solder fused at one time, in the final assemblage, the precaution also facilitates the final soldering.

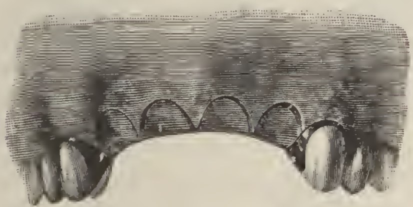
Relationship of Gingival Edge of Facing to Mucosa. Where the natural teeth have been missing for any considerable length of time, and where more or less complete alveolar absorption has occurred, the cast should be relieved immediately beneath the gingival edge of each facing, after it has been ground to fit, in order to insure a firm bearing of the neck of the facing upon the mucosa, as illustrated in Fig. 294 B. If this precaution is not taken, this end of the facing will not rest firmly against the mucosa in the finished fixture.

Recent Extraction. In cases where the restoration is made immediately following the extraction of the roots of the natural teeth, which is a

desirable procedure always, and a necessary one frequently, instead of overlapping the gingival edge of the pontic upon the mucosa, it should be inserted into the socket left open by the extraction of the root.

The depth to which the gingival end of the pontic may be extended, or may project into the socket of recently extracted teeth, varies somewhat in each case, but a projection equal to from one-fourth to one-third of the length of the root, and never exceeding one-third, is safe, generally, and if no irritation presents, the sockets usually close in over and around such projections, and the tissues become hard and dense and remain healthy.

When it is desirable to so place the pontics that their gingival ends project into the sockets left by recently extracted roots, the sockets should



Fir. 294 B.

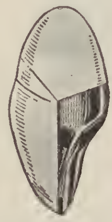


Fig. 294 C.

be packed with aseptic gauze soon after extraction and kept open in this manner until the completion and final mounting of the fixture.

As a means of affording an accurate cast, and of facilitating the proper placement of the projecting gingival ends of facings into the sockets, just previous to taking the bite and the impression, each socket should be filled with a plug of base-plate wax, made plastic and molded carefully in such manner as to fill the socket and to project slightly. If the surplus projection is shaped favorably, these plugs will be removed with and become part of the impression, and, later, of the resulting cast. When the cast has been obtained, the plugs may be removed with boiling water. The necks of the facings then may be placed into the sockets thus formed in the cast with a degree of certainty and accuracy. Pontics so placed afford a more permanent relationship with the mucosa, and provide a correlation which in no way interferes with the normal process of absorption.

Pontics with Porcelain Root Extensions. Pontics having porcelain root extensions, which project into the sockets left by teeth recently extracted, or which are formed in the edentulous tissues for their accommodation by surgical procedure, are used in some cases, and recommended

as an ideal method of procedure. Steele's replaceable facings, or Flat-back facings, may be used, and a special technic is required for each. The completed pontic is illustrated in Fig. 294 C, and the special technic used is described in the construction of posterior pontics.

In the replacement of any single one, or perhaps two, of the six anterior maxillary teeth, when the pontic may be inserted immediately following the extraction of the root, or roots, extensive absorption may be prevented, or delayed appreciably, and normal contour may be preserved thus, for a time, but the advantages are doubtful, both in character and in degree of permanency.

Fig. 295 A.

Fig. 295 B.

While it is recognized that the mucosa takes kindly to the presence of and contact with highly-vitrified porcelain, still no attachment of course ever occurs, and, therefore, in the absence of attachment, a pocket must be present; and in proportion as the area of unattached tissues increases, the area of the pocket increases; and in proportion as the area of the pocket thus formed increases, the possibilities of hygiene and sanitation decrease.

And, hence, pontics with porcelain root extensions must be regarded as ideal but unsanitary restorations.

Final Assemblage on Cast.

Before the final assemblage of facings and backings upon the cast it should be observed that each facing may be detached from its backing easily. When this precaution has been taken, facings and backings should be assembled in proper position on the cast and the relationship of each backing sustained securely with adhesive wax.

When the desired relationship has been sustained, the facings then should be detached carefully and backings and attachments then invested properly and assembled finally with solder.

All-Porcelain Replaceable Teeth.

Wherever the extent of absorption and the requirements of occlusion are favorable, the Goslee tooth or any of the all-porcelain crowns with detachable dowels, ground to similar basal formation, may be used successfully. (Fig. 295 A.)

Restoration of natural tooth form, color and translucency, with a minimum display of metal are the advantages obtainable from the use of all-porcelain replaceable teeth as pontics; but unless the extent of absorption affords an abundance of space, these advantageous features obtain at the expense of opportunities for sanitation. Hence, this type of pontic is not applicable universally.

In the use of this type of pontic the selection should be made with great care and a size of tooth which will require but little or no grinding should be used always. Any extensive grinding beyond that demanded by the requirements of retention to the basic structure, by backing and soldering, is done at the expense of the strength of the porcelain, and weakened porcelain of any form, or shape, only invites failure.

Whenever it is impossible to obtain the exact size in width and length, then the preference should be given to a size smaller, rather than to one larger, in order that grinding to the point of weakening the porcelain may be avoided, and it is well always to select duplicates of each tooth at the same time.

When the selection has been made in accordance with the requirements, a backing of 36 gage pure gold should be made for each pontic by burnishing, or swaging. A retaining dowel then should be fitted and soldered to the backing, using 22 karat solder. After soldering the retaining dowel, the backing should be placed in position again on the pontic and finally burnished and trimmed to the desired adaptation and outline.

Each backing then should be reinforced to the full extent of the demands of strength and contour, as a single unit, which may be done with 22 karat solder by investing again, or by casting. (Fig. 295 B.)

Flatback Facings with Pins.

Flatback porcelain facings having pins made of platinum, or of platinum alloy, baked in them, antedated replaceable facings and this type of

facing was used formerly and exclusively in the construction of pontics for all types of dental bridgework.

In view of the many advantages obtainable from the use of interchangeable, or replaceable, porcelain teeth and facings, however, and in view of the objectionable features presenting and always resulting from the use of facings which are retained in their relation to the basic structure by means of soldering, the field of usefulness of this type of facing in the construction of anterior pontics now is limited. Indeed, there is no longer any excuse for the use of pin facings which are soldered to the basic structure, except in porcelain work.

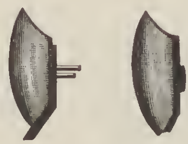


FIG. 296.

When used in connection with gold fixtures, the selection should be made in accordance with all requirements indicated previously for replaceable facings and with the same care. Each facing then should be ground to meet all requirements of adaptation and when so ground should be backed properly.

Since the porcelain facing, which is to be soldered, must be amply protected against stress, the backing must be of uniform thickness, and of adequate strength to insure the protection necessary.

In order that this protection may obtain, the incisal end of the facing should be ground first until a sharp angle presents, as illustrated previously in Fig. 160. Pure gold, about 36 gage, then should be perforated to engage the pins properly, and adapted closely to the facing by burnishing. The backing now should be trimmed to a close, flush joint upon the gingival, mesial and distal surfaces, but allowing a surplus to extend upon the incisal end.

When so adapted, the backing then must be reinforced. Uniform and adequate reinforcement of the backing is secured in the best manner by adapting a supplementary backing made of 22 karat, 28 or 29 gage gold plate, extending from and including the pins and to the incisal end only. When both backings are adapted properly, they should then be united with a small bit of high-grade solder as illustrated previously in Fig. 162.

When each facing has been backed in the manner indicated (Fig. 296), all facings should be assembled in place upon the cast, and the relationship

sustained with adhesive wax, after which they may be invested and soldered. A simple technic for making flat-back facings replaceable is described in connection with posterior pontics.

Posterior Pontics.

In the replacement of missing posterior teeth four general types of pontics are used. These embrace: First, all porcelain replaceable teeth; second, replaceable facings with occlusal surface restorations made in gold; third, flatback pin facings with occlusal surface restorations made in gold; and, fourth, solid cast pontics; and many variations in the methods of procedure in the use of these basic types are followed.

All-Porcelain Replaceable Teeth.

Whenever the extent of absorption and the demands of occlusion are favorable to the requirements of strength and sanitation, an all-porcelain replaceable tooth is the ideal type of posterior pontic.

The conspicuous display of occlusal surface restorations of gold in fixed bridgework construction is and always has been an objectionable feature. The use of all-porcelain replaceable teeth overcomes this and subscribes to the highest possibilities, both in esthetics and in efficiency.

Advantages. The reproduction of natural tooth form in pontics is desirable always and should obtain whenever possible, but it must not obtain at the expense of sanitation. And efficiency, too, is a requirement which must be observed always, but efficiency must not be temporary. It must be permanent.

For actual masticatory purposes, an occlusal surface of porcelain if the glaze is removed insures greater efficiency than an occlusal surface of gold, but porcelain is destructible and gold is indestructible, and these are vital factors in the selection of pontics.

Indications. In the use of all-porcelain pontics, efficiency and permanency may be combined, but they can be combined only when the porcelain may be of proportions sufficient to insure strength, primarily, and when it then may be adequately supported and protected against stress by the metal superstructure.

Whenever all-porcelain replaceable teeth may be used as posterior pontics under these conditions, then the use of this type of pontic is indicated. But where insufficient space presents, and where the requirements of occlusion are exacting, greater indestructibility than is possessed by all-porcelain replaceable pontics may be demanded. And when indestructi-

bility is demanded, and is the first requirement, the use of all-porcelain replaceable teeth as posterior pontics is contraindicated.

This type of pontic also is contraindicated in all cases which do not present every opportunity for sanitation. Opportunity favorable to sanitation demands a more or less extensive absorption of the edentulous tissues in order that the lingual surface of the completed pontic may be of such shape and form, and may be placed in such relationship with the mucosa as to make sanitation possible. An extent of absorption, a

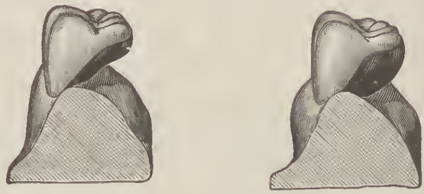


Fig. 297.

relationship, and a shape and form of lingual surface which would make sanitation difficult and practically impossible, and which, therefore, would contraindicate the use of all-porcelain teeth as posterior pontics is illustrated in Fig. 297.

When the indications for the use of posterior pontics of this type are favorable, three types of replaceable porcelain teeth may be used. These embrace the ordinary Diatoric vulcanite teeth, the Goslee tooth, and Steele's interchangeable bicuspids and molars.

Diatoric Teeth. Diatoric bicuspid and molar teeth, designed for vulcanite work, are also well adapted to use as pontics for fixed bridgework.

In the use of Diatoric teeth, the selection as to type, size and color must be made with care, and with a view to avoiding all or any unnecessary grinding. For the reason that the form is favorable, and that grinding to any appreciable extent only weakens the finished pontic, this precaution should be taken always.

Backing. When the selection has been made, each tooth should be adapted properly to all of the requirements of the case, primarily, and then each tooth should be backed with pure gold about 36 gage. The backing may be adapted by burnishing, or by imbedding the tooth in impression compound and swaging. The backing should be so adapted as

to box in the porcelain tooth completely upon all surfaces except the buccal and occlusal.

Reinforcing. When the backing has been adapted and trimmed as indicated, it then should be perforated over the hole in the porcelain and burnished to close contact into and with the walls of the hole. Each backing then should be reinforced heavily and uniformly and contoured to the desired form and shape as a separate unit. The reinforcement and contouring necessary may be done either by casting or with solder.

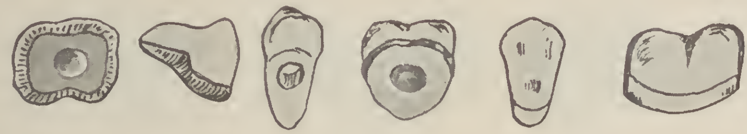


Fig. 298.

Casting. When it is desirable to make the reinforcement and contouring by casting, the interior of the hole should be lubricated with oil, and casting wax then should be pressed firmly into it first, after which all of the reinforcement and contour desired should be made also with casting wax. The sprue-former then should be inserted into the wax at its thickest point, and the investment and casting made.

The use of a backing adapted previously, as indicated, is absolutely necessary as a means of overcoming shrinkage and warpage and of thus insuring accuracy of adaptation when the casting process is used, and the casting should be made with a good grade of casting alloy.

When the casting has been made, if a physical union between the pure gold backing and the alloy used in casting does not obtain, a small bit of high-grade solder should be used, taking care that it does not flow over upon the pure gold. The use of whiting or of any anti-flux will prevent such a mishap.

Each porcelain tooth then should be fitted carefully into its respective backing, and each backing finished to the point of polishing as a single unit. (Fig. 298.)

Before the final assemblage of the pontics upon the cast, previous to investing and soldering, it should be observed that each tooth may be detached easily from its backing. This precaution insures ready detachment of each porcelain tooth previous to investing, and the use of stick adhesive wax will facilitate this procedure.

With Solder. Each pontic must be backed with pure gold, primarily, as indicated, and each backing must be reinforced uniformly and

adequately, and contoured to meet the requirements, as indicated. These features are imperative and may be accomplished best by casting. But, with care, they may be accomplished with solder, though not with the same degree of certainty and accuracy.

When the reinforcement of each backing as a single unit is to be made with solder, a sustaining dowel of a size proportionate with the size of the hole in the pontic and with the demands of strength must be used.

FIG. 299.

Round iridio-platinum, or high-fusing clasp-metal wire, 12 to 16 gage, is used for this purpose.

When the pontic has been backed properly, the backing should be perforated slightly immediately over the center of the hole and a short, blunt, sustaining dowel then forced through the perforation to the full depth of the hole, allowing a surplus to project. The relationship between backing and dowel now should be sustained with adhesive wax, allowing the wax to cover this surface of the backing fully and completely. This precaution will insure a clean surface, freely exposed, when backing and dowel have been removed from the pontic and invested.

Backing and dowel should be invested carefully in soldering investment compound, allowing the wax to remain freely exposed. When the investment compound has crystallized, the wax should be removed with boiling water, the exposed surfaces of backing and dowel fluxed properly, and the investment then heated.

The relationship between backing and dowel then may be sustained and the necessary reinforcement and contour made with solder. Since subsequent soldering in the final assemblage will be necessary, 22 karat solder should be used at this time. When the desired and required rein-

forcement and contour obtain, each backing should be finished and the assemblage upon the cast, and the final investment made, as has been described.

The Goslee Tooth.

The Goslee tooth was designed for universal use in the restoration of the crowns of teeth as single units, and as a pontic for bridgework.

FIG. 300 A.

FIG. 300 B.

In the construction of posterior pontics this, or a similar type of all-porcelain replaceable tooth, is useful. The lingual and retentive surface is convex, both mesio-distally and occluso-gingivally. This admits of a maximum of porcelain and a shape favorable to the requirements of sanitation, and definite angle margins for the adaptation of the backing are provided. (Fig. 299.)

The use of this type of tooth for posterior pontics is indicated in the same class of cases as permit the use of Diatoric teeth. It offers the same advantageous features, and is used in exactly the same manner, and with exactly the same technic as described for the Diatoric tooth. Round iridio-platinum, or clasp-metal wire, 14 gage, should be used for the sustaining dowel, and each tooth should be back with 36 gage pure gold (Fig. 300 A), and the backing reinforced subsequently, either by

casting or with solder, and finished as a single unit as indicated. Reinforced backings, made by casting, are illustrated in Fig. 300 B. Fixtures showing the application of both anterior and posterior pontics of this type are illustrated in Fig. 301.

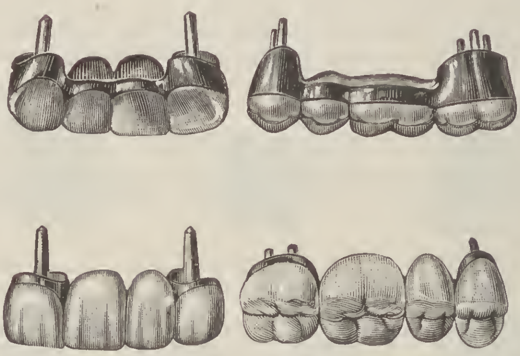


Fig. 301.

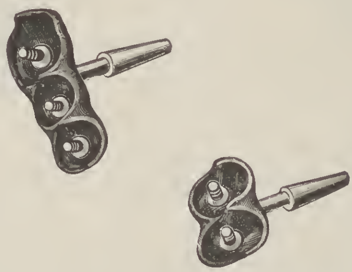


Fig. 302.

Backings Made in Sections of Two or Three. Backings including two and even three teeth may be made in a single unit by backing each tooth first with pure gold, separately, assembling the backings primarily by forming the reinforcement and contour with casting wax, and then casting; or, by investing and making the reinforcement and contour with high-grade solder.

This procedure may be indicated in cases of extensive absorption of the edentulous space, but better results will be obtained, usually, by making each backing as a separate unit.

Backings made in sections by casting are illustrated in Fig. 302.

In the use of pontics of this type, the selection should be made with painstaking care, and duplicates should be provided and the definite formula of mold and color used should be recorded in all cases.

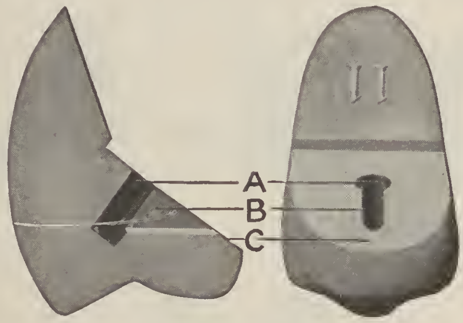


FIG. 303 A.

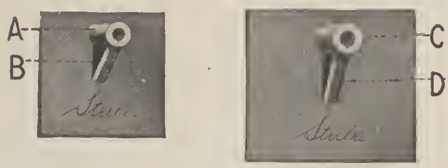


FIG. 303 B.

Steele's Posteriors.

Steele's interchangeable "posteriors" also are a useful type of pontic. (Fig. 303 A.) In the illustration, "A" shows the post hole, "B" shows the rib-slot, and "C" shows the plane surface. On account of the thinness of the occlusal surface of porcelain, this type of pontic, perhaps, is more generally applicable than either of the preceding types, but the shape of the lingual surface of the completed pontic often is not favorable to the highest requirements of sanitation.

Special backings, made both in gold alloy and in base metal alloy are provided in two sizes. (Fig. 303 B.) The post "A" and "C," and the rib "B" and "D" vary in size. Gold alloy backings, however, always should be used. Backings which do not extend to the gingival edge of the tooth, and which do not form a complete box for the porcelain, however,

present an element of weakness. (Fig. 304 A.) Such extensions may and should be made by attaching a small piece of pure gold, 36 gage (Fig. 304 B), to each backing with solder (Fig. 304 C), and after soldering (Fig. 304 D), burnishing the extension to include and overlap the gingival edge. (Fig. 304 E.) When thus backed (Fig. 304 F), adequate

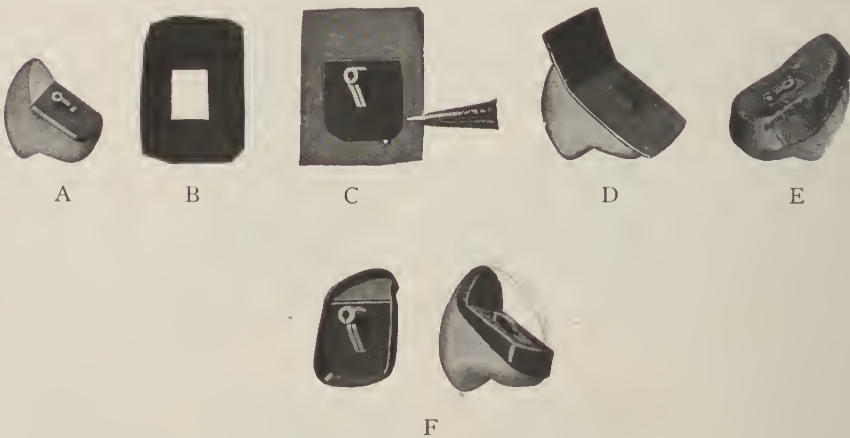


Fig. 304.

reenforcement and desired contour may be made either by casting, or with solder, and this should be done and each pontic finished as a separate unit before the final assemblage.

Use of Tube Teeth.

An all-porcelain pontic to be used in combination with gold, and requiring the presence of an individual saddle resting upon the mucosa beneath each pontic, is known as the "Trubridge" tooth. It is made like Ash and Sons' "tube" tooth, with a round central hole extending entirely through the occlusal surface. A round wire of the same diameter as the hole is attached to the saddle in a vertical line and supports the tooth, which is cemented to place after the completion of the fixture. Porcelain rods are made for the purpose of filling the occlusal surface of the hole afterward.

Because of the objectionable features incident to the use of a saddle in fixed bridgework, this type of pontic is applicable more particularly

to removable structures, though it may be used successfully in fixed structures which are built in gold. The esthetic results, however, are obtained at the expense of sanitation. The use of this type of pontic is described in the chapter on Removable Bridgework.

Replaceable Facings.

Next to the use of all-porcelain teeth, replaceable facings used in combination with an occlusal surface restoration made in gold, as a part of the backing, is the most useful type of posterior pontic.

A B

Fig. 305.

This type of pontic is indicated in all cases where the esthetic requirements demand the use of porcelain, and yet where the stresses of occlusion demand greater indestructibility than is afforded by the use of an all-porcelain tooth.

Steele's replaceable facings may be used successfully in the construction of posterior pontics of this type. In their use, the selection as to size and color should be made with the same care as indicated previously, and backings and duplicates should be obtained at the same time.

Each facing then should be ground to the requirements of adaptation and the backings fitted and trimmed as already described. (Fig. 305 A.) Suitable occlusal surface restoration then may be made as a part of the backing, either by casting or swaging, and each pontic should be made as a single unit primarily.

Casting. When the occlusal surface restoration is to be made by casting, which is the best and simplest procedure, each respective facing and backing should be placed in position on the cast and the requirements of contour and occlusion met by molding casting wax to the backing, and then forming and carving the wax to the desired outlines of the occlusal restoration. (Fig. 305 B.)

It should be observed that the backings are clean and free from oxidation, and that the casting wax is attached securely, and all of the require-

ments of occlusion, and of typical tooth form, should be obtained by carving.

When these requirements have been observed, the facing should be detached carefully, the sprue-former attached securely at a favorable point in the wax, and backing and wax invested carefully and the casting made. Gold alloy backings should be used always. A good grade of casting alloy, fused and cast properly, will attach securely to the backing, provided that the mold is not overheated before casting.

Fig. 306 A.

Fig. 306 B.

In investing, it must be observed that the exposed surface of the backing is covered entirely and thus protected with the investment compound, and in order to prevent unnecessary disintegration, the mold should be burned out and heated carefully, and never overheated before casting.

When the casting has been made it should be cleaned in the acid bath, the facing fitted, and the pontic then finished to the point of polishing, as a single unit. When each pontic has been completed in this manner, it should be observed that the facing may be detached easily. The pontics then should be assembled on the cast, the relationship sustained securely with adhesive wax, the facings then removed and the case invested, and the final assemblage with solder made.

Swaging. When the occlusal surface restoration is to be made by swaging, any of the die, or die-plate methods of forming the occlusal surface may be used successfully, and 22 karat gold plate, 28 to 30 gage, should be used.

When suitable dies have been selected, and the swaging completed, the buccal surface of the occlusal restoration should be trimmed away as indicated in Fig. 306 A, and then fitted carefully and closely to the desired relationship with the facing and backing. This relationship then should be sustained with adhesive wax (Fig. 306 B), and the facing detached.

Backing and occlusal restoration now should be invested, and soldered, in which procedure all of the desired contour of the lingual surface should be made. While the desired contour may be formed with solder alone, it may be facilitated greatly by the use of small spheroids of 22 karat gold plate, previously prepared. These are not fused with the solder, and, hence, any desired contour is obtainable with ease, and when finished withstands the final assemblage without change of form.

Fig. 307.

When the soldering and contouring have been completed, the same procedure indicated for casting then should be followed carefully.

Swaging in Sections of Two or Three. Two, or even three, pontics may be made in this manner at one time by carving special occlusal surface restorations, making special dies in fusible alloy, and swaging all in one piece, as illustrated in Fig. 307. No advantage obtains from this procedure, however, and proper and individual lingual contour is made more difficult.

Flatback Pin Facings.

Flatback porcelain facings, having pins baked in them, combined with gold occlusal surface restorations, and all united with solder, were the primitive type of posterior pontics, and pontics made in this manner are still used.

The use of pin facings which are attached to the superstructure by soldering, however, must be regarded generally as an antiquated method of procedure and as a method offering no possible advantages, but some objectionable features.

The objectionable features incident to the use of pin facings soldered to the superstructure have been considered elsewhere, but may be enumerated again as follows:

First: The presence of pins baked into the porcelain weakens the facing to begin with; second, the influence of heat and of expansion and contraction in soldering further endangers their strength; and, third,

opportunity for replacement and repair with any degree of facility does not present.

In view of these objectionable features, and of the advantages obtainable from the use of replaceable facings, the use of pin facings which are soldered to the basic structure does not afford a type of posterior pontic which subscribes to the maximum of requirements.

Fig. 308 A.

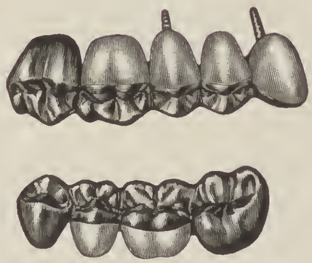


Fig. 308 B.

In the primitive method of using pin facings in the construction of posterior pontics, the occlusal surface restoration was made by swaging. It then was filled to its full depth with solder. The occlusal end of the facing then was ground flat and at a right angle with the buccal surface. The facing then was backed with thin, pure gold, and facing and occlusal surface restoration invested and attached with solder. The finished pontic presented an entire occlusal surface of gold. This extensive display of gold is unnecessary and objectionable and is overcome now by trimming away the buccal surface of the occlusal restoration, and so fitting the facing to it as to avoid any unnecessary display of gold and to present but a minimum line upon the buccal surface of the completed pontic. The comparative esthetic results are illustrated in single pontics in Fig. 308 A, and in completed structures in Fig. 308 B.

Soldering. In the construction of posterior pontics of this type, the facings should be selected as indicated, but duplicates are unnecessary if they are to be attached by soldering. When the selection has been made, each facing should be ground to meet the requirements of adaptation. They should be backed then with pure gold, about 36 gage, leaving a slight surplus project beyond the occlusal angle. (Fig. 309 A.) The

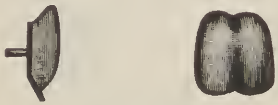


Fig. 309 A.

Fig. 309 B.

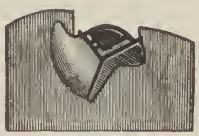


Fig. 309 C.

Fig. 309 D.

backing should be retained then in its relation to the facing by bending the pins over upon it, as illustrated previously.

The occlusal surface restoration then is made by swaging, and when swaged and trimmed to the outlines desired, the buccal surface should be cut away to the occlusal angle. (Fig. 309 B.) Facing and backing now should be fitted to each other in such manner as to present only a thickness of gold at the occlusal angle which will be adequate to protect the porcelain. When fitted in this manner the relationship should be sustained with adhesive wax, and then invested as indicated in Fig. 309 C. The final assemblage and the contour required then is made with solder, as described previously. (Fig. 309 D.)

Casting. In the use of pin facings in the construction of posterior pontics, the occlusal restoration may be made also by the casting process. In the use of the casting process, however, it is not necessary, nor is it desirable, to cast directly to the porcelain facing. And, if this is not done, the advantages of a replaceable, or a cemented facing may be obtained.

In making the occlusal restoration by casting, and to obtain the advantages of a cemented facing, the facing should be ground and backed

as indicated, except that the pins should not be bent over upon the backing, but should be made straight and parallel.

With the backing in position on the facing, the pins should be lubricated with oil, and a piece of casting wax of suitable proportions heated in water and then molded over the projecting pins and against the backing. The casting wax then should be sealed to the backing securely around all

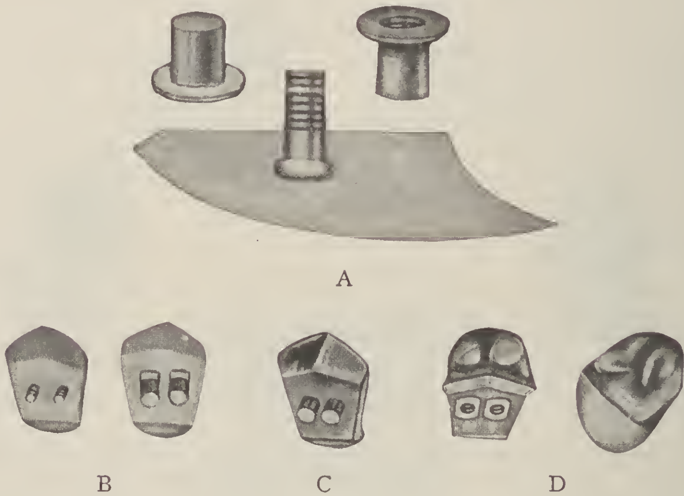


Fig. 310.

edges, using a heated spatula. It then should be contoured and carved until the desired outlines obtain.

The facing now should be teased loose and detached carefully from backing and wax, and, when removed, carbon points of the same diameter of the pins are introduced through the holes in the backing, and to the full depth in the wax.

The investment and casting then should be made, after which the carbon points may be removed by boiling in dilute hydrochloric acid. The holes formed by the carbon points should be reamed out with a spear drill, or round bur, of similar diameter, and the facing fitted to place. The assemblage on the cast should follow, the facing should be removed and the final investment and final assemblage with solder made.

Flat-back Facings Made Replaceable. A simpler and much better method of making a flat-back facing replaceable comprises the use of what are known commercially as "Lockit Cups." (Fig. 310 A.) In

the use of these simple agencies it should be observed that the pins are straight and parallel. They should then be threaded, and a cup placed over each. The threading of the pins is recommended for the purpose of facilitating cementation. (Fig. 310 B.) A backing of 36 gage pure gold should now be adapted to facing and cups, the relationship sustained with wax, the facing then removed, and backing and cups invested and attached with a small bit of solder. (Fig. 310 C.)

The occlusal surface restoration may then be made and the pontic completed by casting, or by swaging and soldering, as described pre-

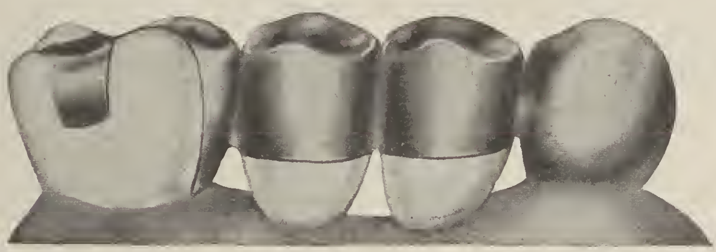


FIG. 311.

viously. (Fig. 310 D.) This simple technic makes a useful pontic, affords all of the advantages of a replaceable facing, and constitutes the only way in which a flat-back facing should be used.

Gingival Extensions of Porcelain.

If the highest requirements in the direction of health conservation, and of sanitation could be met in all cases, and at all times, the ideal pontic would be one made entirely of porcelain. But the requirements of stress and strength, and the inherent weakness of porcelain demand greater indestructibility. The advantages obtained from placing a surface of highly vitrified porcelain in contact with the mucosa, however, may be achieved by combining gold and porcelain, and making posterior pontics having gingival extensions of porcelain, as suggested by Dr. E. T. Tinker. (Fig. 311.)

Pontics of this type, unquestionably, are the nearest approach to the ideal, and the most sanitary type of construction, but they are not applicable universally. The field of usefulness is limited to those cases where the extent of absorption permits the use of pontics of consider-

able occluso-gingival length, and in such cases pontics of this type afford the highest type of construction.

A knowledge of porcelain work, and an exactness of technic are demanded in the construction, and either Steele's replaceable facings, or posteriors, or flat-back facings may be used.

In the use of Steele's replaceable facings, or posteriors, special "angle backings" and "root-sections" are provided for this work, and a special

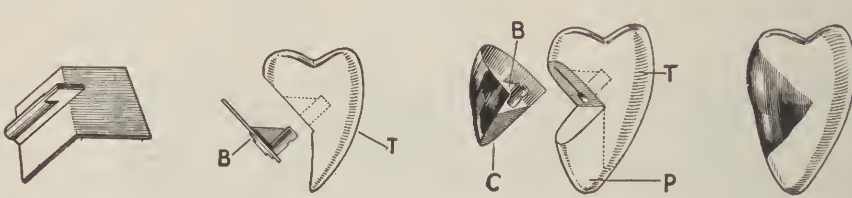


Fig. 312 A.

Fig. 312 B.

technic is required. (Fig. 312 A.) Flat-back facings also may be used in the manner illustrated in sequence in Fig. 312 B.

The facings should be selected, ground, and the gingival extension made in porcelain, and of such proportions as will admit of resting gently upon the mucosa, leaving large, free, open interproximal spaces between the pontics themselves, and between the pontics and the attachments.

When the gingival extension is so formed, and adapted properly by final grinding, it is then re-fused and carried to a point which presents a highly vitreous surface. The pontic then should be backed with pure gold, 36 gage, and the contour and restoration desired made in casting wax. The facing should be removed, and the occlusal surface restoration made by casting.

The use of "Lockit Cups" facilitates the procedure, and affords all of the advantages of a replaceable facing.

Facings and occlusal surface restorations, finished as single units, are assembled, the facings removed, and the case invested and assembled finally, with solder, in the manner described previously.

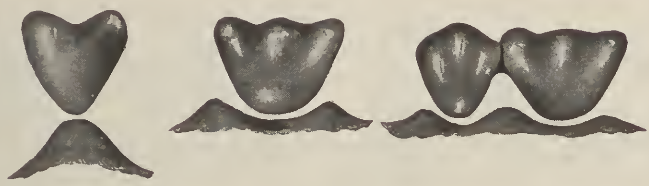


FIG. 313.

Wherever the extent of absorption and the requirements of occlusion will permit the use of this more or less ideally sanitary type of pontic, a conservation of health, and increased opportunities for sanitation obtain.

Solid Cast Pontics.

In the replacement of missing posterior teeth, many cases present where the requirements of esthetics are not exacting, where opportunity for sanitation is of greater importance, or where the requirements of occlusion demand absolute indestructibility. In such cases the use of a solid cast pontic may be indicated, as the best means of obtaining a maximum of combined requirements in the restoration of function.

Solid cast pontics for posterior teeth may be made separately as single units, or to involve and include two, or even three teeth in one section.

In the construction of this type of pontic, whether as a single unit, or including two or three teeth, the most ideal formation from the viewpoint of sanitation is obtainable from a triangular shape, with the apex of the triangle presenting toward, and approaching closely to, the mucosa. (Fig. 313.)

If this general formation obtains, and if large interproximal spaces between the pontic and the attachment present, all surfaces are exposed freely, may be reached by the tooth-brush nicely, and may be kept clean easily.

The so-called "self-cleansing" type of occlusal restoration which includes the restoration of the occlusal surface only, types of which are

illustrated in Fig. 314, is a travesty on the possibilities of sanitation. Mouth hygiene and oral sanitation demand that all surfaces of dental bridgework which is attached in a fixed manner should be exposed and accessible as nearly as possible always; but this cóndition does not obtain beneath simple occlusal surface restorations, and hence, "self-cleansing" is a fallacy, and this type of construction is to be condemned.

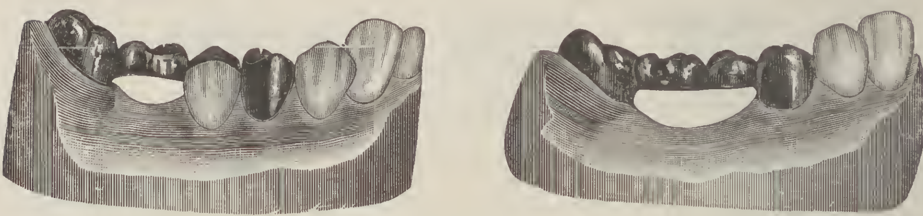


Fig. 314.

In the construction of solid cast pontics, casting wax made plastic in hot water should be molded to the cast, in such manner as to fill completely the edentulous space between the attachments and to accommodate the requirements of occlusion. The cast should be varnished previous to molding the wax as a means of preventing its becoming attached thereto.

When molded to meet all requirements, the wax should be detached and then carved to the shape and form desired and required. The sprueformer now should be attached securely and the investment and casting made. The casting should be made of a good grade of casting alloy similar in color to the alloy used in making the attachments. After the casting has been made, the pontic should be finished as a single unit and finally assembled, invested and soldered.

Silicate Cement Facings.

Aside from a failure to subscribe to the requirements of esthetics, the chief objection to solid cast pontics made in the manner described lies in the more or less extravagant use of gold, and the weight of the finished fixture resulting therefrom.

Esthetic features may be increased and the amount of metal otherwise required may be reduced to advantage often and without deviating from the desired shape and form of the completed pontic, by the use of silicate cement. Whenever these features and possible advantages may be desirable, suitable accommodation for the silicate facings should be provided in the wax pattern just previous to investing.

This may be accomplished by removing the entire buccal surface of the wax pattern and forming a cavity of retentive shape and with definite margins, and as deep as may be practical, in the body of the pattern. The formation of the cavity in the wax pattern is made easily by the use of a large, round bur in the engine and a sharp carving instrument, or with the "suction carver" designed for similar purposes. When all unnecessary thickness of wax is reduced, and when the requirements of retention have been met, as illustrated in Fig. 315, the pattern then should be invested and cast.

Fig. 315.

When the casting has been made, the pontic should be finished and assembled as indicated previously. The silicate cement facing should not be placed until just before the fixture is to be mounted, and should be polished smoothly before mounting. Much artistic effort may be displayed in the construction of posterior pontics in this manner, but the advantages obtained will depend upon the permanency of the silicate cement. If any doubt as to the permanency of these products prevails, the same advantageous features may be obtained by burnishing a matrix and making a baked porcelain inlay.

Bucco-Lingual Dimensions of Posterior Pontics.

While the restoration of function is one of the imperative requirements of posterior pontics, still the abutment teeth receive all of the stress assumed by the pontic. Therefore, in proportion as the stress imposed upon the pontics may be diminished without destroying their usefulness, the degree of stress which must be assumed by the abutments likewise will be diminished correspondingly. Hence, the dimensions of the occlusal surface restorations of all posterior pontics never should be greater than the actual requirements of usefulness demand. And, furthermore, in proportion as the bucco-lingual dimensions of posterior pontics are reduced, the opportunities for sanitation are increased.

The mesio-distal dimensions cannot be reduced beyond the requirements, but the bucco-lingual dimensions may be and should be confined to the requirements of restoration of function only, and should be held within these limitations at all times.

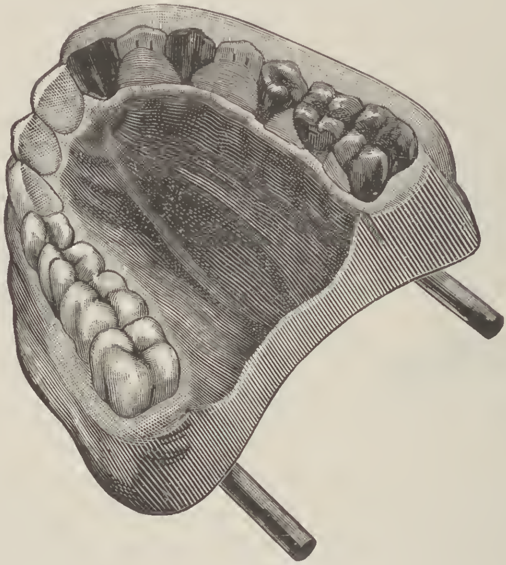


FIG. 316.

Articulation of Pontics.

The articulation of the pontics is important, and should be observed carefully, and with a full comprehension of the requirements of functional occlusion.

If the pontics are improperly articulated one of two evils must result. Either they will be in a position of malocclusion with a proportionate reduction in masticatory efficiency, or they may be so incorrectly placed in relation to the occlusal planes as to induce traumatic occlusion, or result in fractured porcelain teeth or facings.

Assembling.

Since no structure which is designed to endure can be stronger than its weakest point, the final assemblage of all of the single units of which the fixture is composed is an important procedure in the construction of fixed bridgework.

Requirements. The requirements of assembling, therefore, must be observed in detail and with great care. These requirements are as follows:

First: When all of the single units have been completed and finished to the point of polishing, they should be assembled in proper position and relationship on the cast, and the position and relationship then sustained securely with adhesive wax. (Fig. 316.)

Second: All surfaces of metal which are to be and which should be exposed in the investment, as a means of facilitating the final assemblage with solder, then should be covered with wax also.

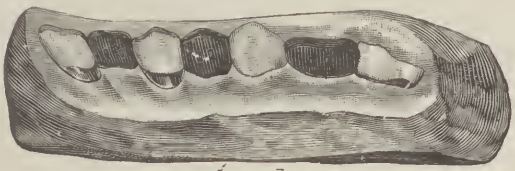


Fig. 317 A.

Third: The cast now should be removed from the articulator and immersed in cold water until all confined air is dispelled. This will be indicated when air bubbles cease to rise.

Fourth: A high grade of soldering investment compound, which crystallizes, should be mixed to the proper consistency, and then applied freely to and over all surfaces of metal, or of porcelain, which have not been covered by wax.

Fifth: When the investment has crystallized the wax should be removed with boiling water.

Sixth: When all wax and residue have been removed, all surplus overhanging edges of investment should be trimmed away until a free exposure of all surfaces which should be exposed obtains.

Seventh: The entire investment then should be reduced by trimming away all unnecessary surplus and leaving the final investment of proportions no larger than necessary to insure strength, and to withstand heat. (Fig. 317 A.)

Eighth: All particles of débris must be removed, and all surfaces of metal must be clean.

Ninth: All parts to be assembled must be in apposition and if absolute contact does not obtain small pieces of wire or of plate should be fitted carefully into the joint.

Tenth: All surfaces to which solder is to become attached then

should be fluxed properly with borax mixed into a thin paste, and the case then placed over a flame and allowed to remain until heated thoroughly, before attempting to effect the final assemblage with solder.

Anterior Fixtures. In the final assemblage of fixtures involving the six anterior teeth, it is necessary always to adopt some means of insuring adequate strength, while preserving the individuality of each facing, when facings are used, by preventing the complete union of the backings from the gingiva to the incisal end.

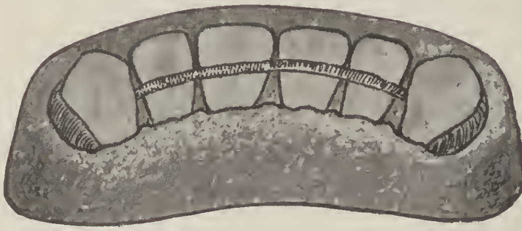


Fig. 317 B.

Nothing adds more to the esthetic features of anterior fixtures than the absence of any display of gold in the interstices, and, hence, it should be observed that the backings do not come in direct contact at the incisal ends. Filling in between the incisal ends of the backings with a thin solution of whiting before the case is heated, which may be done easily with a small, pointed brush, will prevent the solder from running into the joint and uniting the backings at the extreme incisal ends.

As this procedure usually will leave but a very small portion of the backings in direct contact, extreme care must be exercised to obtain the necessary strength in the assemblage. Adequate strength may be insured, however, by fitting a piece of round iridio-platinum, or clasp-metal wire, about 18 gage, across the backings at about the center, and from cuspid to cuspid, before the case is heated, and then uniting the backings only over and around this wire. (Fig. 317 B.)

If each backing has been reinforced previously, adequate strength, and a better lingual contour will result. In this connection it is always desirable to carry as small a quantity of solder to a fluid state at one time as possible, in order to minimize shrinkage, and the value of the use of wire in this manner, therefore, is apparent.

Posterior Fixtures. No special precautions, other than those indicated, are demanded in the assemblage of posterior fixtures, but it must be observed that the requirements of strength and contour obtain always.

Soldering. All of the precautions incident to soldering which have been emphasized previously must be taken, but by way of special emphasis, it should be remembered that no effort to solder ever should be made until the case has been allowed to remain on the burner sufficiently long to become heated thoroughly.

If the surfaces of metal and solder then have been fluxed properly, but little effort will be required, and the ordinary combination blow-pipe will answer the purpose. While compressed air may be used in extensive

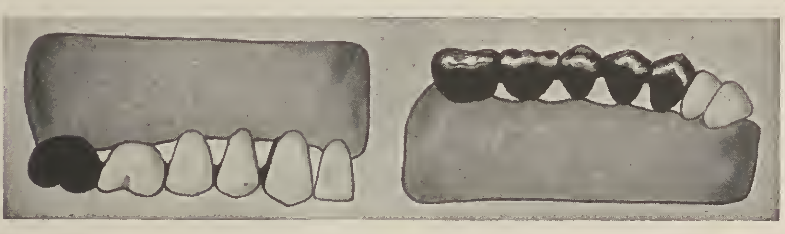


Fig. 318.

cases requiring large investments, still, to regulate and control the heat with the mouth blow-pipe is manifestly more reliable and safer.

In the management of a large mass of solder, such as is required in assembling extensive fixtures, the procedure may be facilitated greatly by cutting the solder into good-sized pieces, and then using the sharpened point of an ordinary slate pencil to pull, push, or guide it to the desired point when in the state of fluidity, and, in placing the solder, long, pointed pliers may be used with more comfort, of course, than short ones.

When considerable filling in, or contouring is required, previously melting gold plate, or scrap, into globules of various size, and then placing these properly before fusing the solder, also will facilitate and expedite the work of soldering.

When the soldering has been completed, the heat should be discontinued, and the case allowed to cool slowly, before removing from the investment. When removed, it should be cleaned in boiling dilute hydrochloric acid, then finished to the point of polishing, after which all replaceable teeth, or facings, should be cemented, and the final polish given.

Final Considerations.

Throughout the construction and application of fixed bridgework successful achievement will depend, not so much upon the method used, nor upon the technic followed, as upon a knowledge and observation of correct basic principles.

In the building of fixed bridgework the basic principles which must be observed always, embrace and include, first, a correct relationship between the abutments and the attachments; second, a correct relationship between the attachments and the pontics; third, a correct relationship between the pontics themselves; and fourth, a correct relationship between the pontics and the mucosa.

This relationship is illustrated typically in Fig. 318.

Fig. 319.

Some idea of the highest esthetic possibilities in the replacement of missing teeth by means of fixed bridgework is illustrated, through the courtesy of F. P. Worth, in Fig. 319.

Whatever may be the shortcomings of fixed bridgework, and however far it may be from a physiologically ideal method of procedure, when used only where indicated, and when built along the lines suggested, no indictment not supported by damaging clinical evidence is rational or tenable.

And, if clinical evidence is of value, and, if the legend, "a survival of the fittest," may be applied to the methods of replacing missing teeth and holds true, fixed bridgework will be doing good service when all other methods, except clasp and full dentures, will have been abandoned, or forgotten.

Basic Rules.

The following basic rules may be regarded as fundamental to the successful application of fixed bridgework:

1. Primarily, all conditions must be favorable.
2. Favorable conditions demand good health, and every opportunity for proper sanitation.
3. While the most ideal physiological conditions present when only teeth of similar functional activity are involved, and when the abutment teeth may move slightly independent of each other, while functioning, yet neither is imperative.
4. Sound basic mechanical principles must obtain in all cases.
5. The teeth are capable of withstanding stress in excess of their own normal functional demands to a limited degree.
6. One tooth will do the work of two teeth under favorable conditions.
7. The distribution of the abutments must be favorable to the requirements of stress and strength in all cases.
8. Usually the number of abutment teeth should be equivalent to the number of missing teeth to be replaced.
9. When the number of pontics to be supplied exceeds the number of abutments, the strength of the abutments must be equal to the requirements of stress.
10. A greater number of abutments than is required to meet the demands of stress and strength is not necessary and never should be used.
11. Never more than one pontic should be suspended from the abutment, or abutments.
12. When one pontic is suspended from one abutment, the pontic never should be larger than the abutment.
13. When one pontic is suspended from one abutment, the abutment and not the pontic must assume the burden of stress.
14. In designing and planning fixtures of any size it is necessary to recognize that the first molar is the center of masticatory stress, and that the degree of stress diminishes as it radiates from this common center.
15. A pontic may be suspended anterior, but never posterior, to the abutment, or abutments, except to prevent elongation of opposing, or migration of adjacent teeth.
16. In suspending a single pontic from a single abutment in the region of the anterior teeth, a provision against rotation of the abutment, and lateral displacement of the pontic, must be made.

17. In suspending a single pontic from a single abutment in the posterior teeth, the efficiency of the pontic will depend entirely upon adequate provision against vertical stress.
18. A first bicuspid pontic never should present an occlusal surface of normal proportions.
19. Whatever type of attachment is used, it must fit.
20. Whatever type of pontic is used its shape must insure sanitation.
21. Whenever porcelain teeth or facings are used they should be of the replaceable type.
22. Large interproximal spaces between attachments and pontics and between the pontics themselves must present always.
23. In the assemblage of attachments and pontics, the soldered joint should involve the immediate contact points only, in anterior fixtures, and the occlusal one-third only, in posterior fixtures.
24. The structural formation of fixed bridgework possesses no greater strength than obtains at its weakest point.
25. Strength adequate to the requirements of stress must obtain in every part of the fixture.
26. The gingival edge of all anterior pontics should be rounded and smooth, and should rest firmly upon the subjacent mucosa.
27. The gingival edge of all posterior pontics may touch but never should rest firmly upon the subjacent mucosa.
28. The bucco-lingual dimensions of posterior pontics never should be greater than actual efficiency demands.
29. No form of saddle of any size or shape resting upon the subjacent mucosa ever should be used in fixed bridgework.
30. The greatest success in fixed bridgework will result in cases in which two, three, four, five, and possibly six, teeth are involved.
31. Where more than six teeth, and where bilateral fixtures of the complex type are involved, successful application will depend entirely upon favorable conditions, correct mechanical principles, careful technic, and diligent sanitation.
32. A careful mounting and a final adjustment to and checking up of the requirements of functional occlusion after mounting must be observed in all cases.
33. Each fixture should be finished well and polished like a piece of jewelry before it is mounted.

CHAPTER XVI.

PORCELAIN BRIDGEWORK.

The successful application of the ceramic art to the restoration of the crowns of teeth as single units, together with a recognition of the almost unlimited possibilities for achieving the highest requirements in esthetics, hygiene and sanitation, at one time encouraged a wave of enthusiasm in applying ceramics to the broader field of bridgework. Disaster followed in a large proportion of cases.

Porcelain ranks first in subscribing to the requirements of esthetics, hygiene and sanitation. It ranks absolutely last in relation to the requirements of strength. And strength is a basic and essential element in the replacement of missing teeth by any method.

Hence, because of the inherent physical weakness of porcelain itself, porcelain bridgework is not applicable universally. It is recognized now only in a limited field of usefulness.

Indications. Porcelain bridgework is limited to cases in which the requirements of esthetics are the primary consideration.

And, even in cases of this type, porcelain bridgework will be successful only when the porcelain may be supported and protected properly and adequately by the superstructure itself.

When porcelain is used under these conditions and its application is confined to small restorations which involve the replacement of but one, two, three, or, perhaps, four teeth in a single fixture, all of the advantages of porcelain may obtain successfully—but only under these conditions.

Attachments. Full dowel crowns, made with platinum copings and platinum pin facings, or full telescope crowns, made in platinum, are the only types of attachments which may be used successfully in porcelain bridgework, due to the fact that the attachments, as well as the pontics, must be subjected to and must withstand successfully the degree of heat required to fuse the porcelain.

Dowel Crowns. In the use of dowel crowns as attachments for porcelain bridgework, the strongest form of coping is obtained by making

the band of 28 or 29 gage platinum, with lapped joint, as illustrated in Fig. 320.

When the band has been made and fitted, as described previously, and trimmed to the width desired, a floor of platinum, or of iridio-platinum, 30 to 32 gage, should be attached. The dowel then should be made of round iridio-platinum wire 14 to 16 gage. In enlarging the canal and in

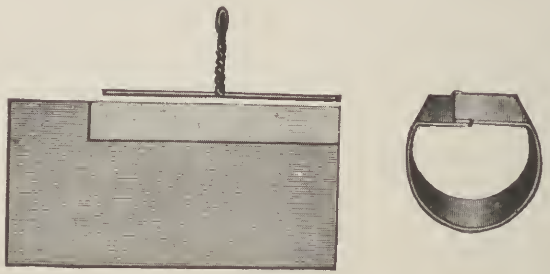


Fig. 320.

perforating the floor of the coping to receive the dowel, the surplus end of the dowel must project through the coping at a point far enough toward the lingual edge of the basal surface to permit of the proper placement and alinement of the facing at the gingival end.

When the coping has been completed, the bite and impression should be taken and the cast made. Precautions providing for the ready detachment of the coping from the cast should be taken.

A flat-back facing, having platinum pins, then should be selected and ground to the desired adaptation to the coping. The coping then should be detached from the cast, replaced, and the relationship between facing and coping sustained with adhesive wax, after which they should be removed, invested and soldered.

After investing, and just previous to soldering, the pins of the facing should be bent toward the coping in such manner as to bring them in contact with the surplus end of the dowel, or with the floor of the coping, as illustrated in Fig. 321.

This precaution insures strength in the attachment of the facing to the coping and provides accommodation for a maximum of porcelain. And it must be remembered that the strength of porcelain increases in proportion as its bulk increases.

Telescope Crowns. In the use of full telescope crowns as attachments for porcelain bridgework, the band should be made of 28 gage platinum, with a lapped joint, as described. When fitted and contoured as required, the occlusal surface restoration should be made by the indirect

FIG. 321.

A B

FIG. 322.

method, and by swaging. Any necessary reinforcement of the occlusal surface restoration, after uniting it to the band, may be made by swaging a second, or duplicate piece and fitting it to the inside of this surface of the crown, and then attaching the two with solder.

Adequate reinforcement may be made also by fusing porcelain over this surface of the crown upon the inside after the assemblage of all the single units composing the fixture, and at the time of baking the porcelain.

No type of partial-crown restoration can be made in platinum, or can be used in porcelain work, except pin inlay attachments. And pin inlay attachments to be used in this work must be made with a platinum matrix and iridio-platinum pins, united with 25 per cent. platinum solder, in order that they may withstand the fusing of the porcelain.

Assemblage. When the attachments are completed as single units, they should be placed in position on the abutments and the final bite and impression taken, and the cast made as previously described.

The final cast always should be made with investment compound, and the attachments never should be detached from the cast until after the final assemblage.

Anterior Fixtures. In the construction of anterior fixtures in porcelain, as soon as the cast with the attachments in position has been ob-

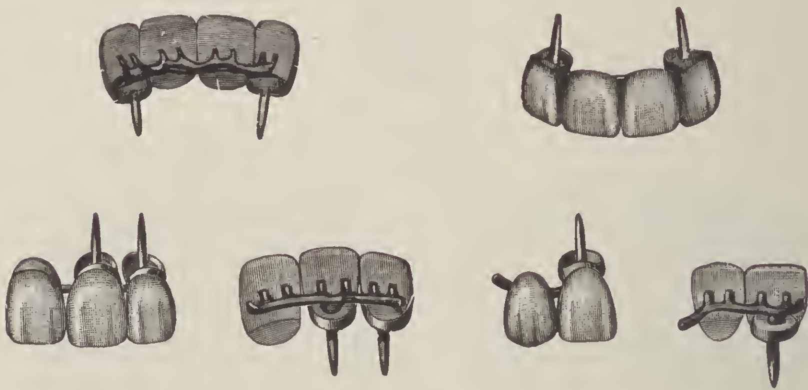


FIG. 323.

tained and mounted upon an articulator, the pontics should be selected and adapted.

The labial surfaces of attachments and pontics then should be covered completely with investment compound, after which the cast should be removed from the articulator and the whole trimmed down until just large enough to sustain the relationship of the various units and to insure strength.

When the investment has been trimmed to the size and outlines desired, the lingual surfaces of copings and facings should be exposed freely, as illustrated in Fig. 322 A.

Round iridio-platinum wire, about 16 gage, then should be fitted carefully in such manner as to rest firmly upon the basal surface of each coping, and to afford close contact with each pontic and each pin, as illustrated in Fig. 322 B. If contact between the pins and the assembling wire does not obtain easily, each pin should be bent to close contact; and the assembling wire should be placed in close apposition to the facings in order that it may offer no interference with the restoration of the desired lingual contour in porcelain. When the assembling wire has been fitted in this manner, the case then should be heated and each point of contact soldered in such manner as to insure strength.

After the assemblage has been completed, the case should be allowed to cool slowly, then removed from the investment, cleaned in the acid bath, and finished roughly with stones and disks. All sharp edges and angles of assembling wire and pins should be rounded nicely and every opportunity for the restoration of contour with porcelain should be afforded.

Typical cases, involving the replacement of missing anterior teeth, together with structural requirements, are illustrated in Fig. 323.

FIG. 324.

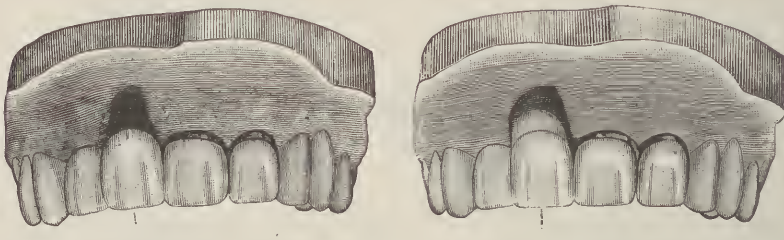
Through the tendency of the natural teeth to migrate toward an edentulous area, a condition in which a single abutment must be required to support two pontics, presents occasionally. In such cases the best results may be obtained by sacrificing the remaining natural crown of the abutment tooth, and using its root with a single coping as a means of replacing its own crown, together with the missing tooth. (Fig. 324.)

In cases of this type the best results are obtainable with porcelain. When the coping has been made of platinum, as indicated, it should be placed in position upon its supporting root, the bite and impression taken, and the cast made of investment compound.

When the cast has been obtained, platinum pin facings of the proper color and size should be selected and ground to the required adaptation. Then they should be soldered to the coping, taking all precautions previously indicated, after which the desired contour may be obtained in porcelain. By using gum enamel, any display of the platinum coping between the gingival ends of the facings may be avoided. Esthetic features not to be obtained in any other manner are possible in cases of this character.

Restoration of Gingival Tissue. In cases of extensive loss of tissue as a result of surgical procedure, or of long-continued absorption, and as a means of subscribing to the esthetic demands of the individual case, particularly in the replacement of single missing anterior teeth, some restoration of the gingival tissues is often necessary.

The pontics, in such cases, must never appear to be longer than the crowns of the remaining natural teeth. Therefore, if esthetic results



A B

Fig. 325.

Fig. 326 A.

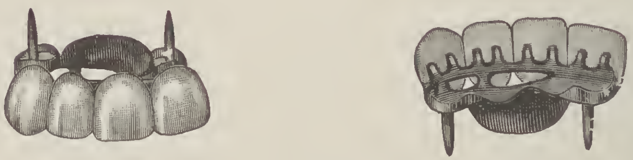


Fig. 326 B.

are to be secured, a restoration of the gingival tissue must be made with gum enamel, and this should be done previous to assembling the pontic and its attachments.

This restoration is easily constructed by selecting the facing to meet the requirements of the case (Fig. 325 A), and then building the necessary restoration with gum enamel, subsequently grinding the restoration to conform to the adaptation. (Fig. 325 B.)

Any type of facing having platinum pins may be used, and one slightly longer than necessary facilitates the procedure. In building such restorations, two and sometimes three, bakes will be required, and any of the gum enamel bodies which produce the color desired may be used.

Less extensive, but equally typical conditions of this type are illustrated in Fig. 326 A. A more extensive restoration, involving the replacement of two teeth, together with the structural requirements, is illustrated in Fig. 326 B.

Fig. 327 A.

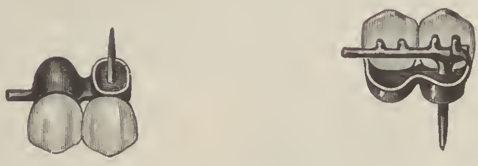


Fig. 327 B.

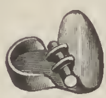


Fig. 327 C.

While a saddle of any form, or shape, is indicated rarely in the construction and application of fixed bridgework for sanitary reasons; still, if gingival restoration is demanded the adaptation is facilitated by the use of a very thin gage of platinum adapted to the proper outlines previously by burnishing, or by swaging, and making it a part of the structural formation of the fixture.

Posterior Fixtures. The successful application of porcelain in posterior restorations is limited to small fixtures only, owing to the increased demands of occlusal stress.

The replacement of missing first bicuspids by attachment to a dowel crown restoration on the second bicuspid, may be made successfully if provided with a lingual rest, as illustrated in Fig. 327 A. And the re-

placement of a missing second bicuspid, by attachment to a dowel crown restoration on the first bicuspid, also may be made successfully if provided with an occlusal support resting in an inlay in the first molar, as illustrated in Fig. 327 B.

In the latter type of fixture, if the second bicuspid pontic must present an occlusal surface restoration, then a small saddle must be used to support the restoration, and the pontic must be built as a single unit, as illustrated in Fig. 327 C. But, if occlusal surface restoration is unnecessary, or if a simple facing may meet the requirements, then the use of a saddle may be avoided, and a more sanitary type of fixture will obtain.

Fig. 328.

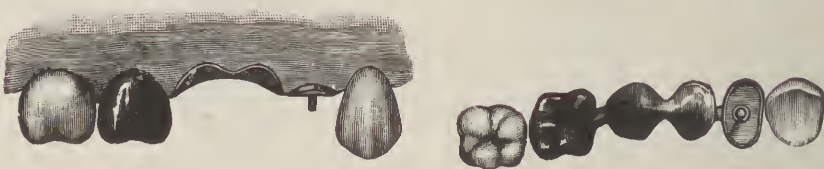


Fig. 329.

Use of Saddles.

In more extensive cases where the esthetic requirements may be extraordinary, demanding the use of an all-porcelain fixture, even though its application is made at the expense of some of the requirements of sanitation, results, successful in every other particular, may be obtained.

But successful results in posterior restorations, which involve and require a reproduction of the occlusal surfaces of the pontics, are obtainable only by means of a saddle resting firmly upon the mucosa beneath each and every pontic. In such cases complete absorption of the edentulous tissue must present, primarily, and the use of a saddle would be, then, but another instance of a choice of evils.

The attachments should be completed first, in effecting the required accuracy of adaptation of a saddle in the construction of fixed bridgework in porcelain. Upon completion, they should be placed in position

on the abutments and an impression taken in plaster. In removing the impression, the attachments may, or may not, be removed with it. If they are removed with the impression, they should be detached therefrom, and laid aside. The impression then should be allowed to dry thoroughly, and each end filled in, either with plaster or moldine.

The impression, prepared in this manner, then should be poured with fusible alloy, which affords an accurate die. A counter-die then should be made, also with fusible alloy, as described previously, and as illustrated in Fig. 328.

The saddle then should be formed by swaging, using platinum of about 30 gage. When swaged, the saddle should be trimmed in such manner

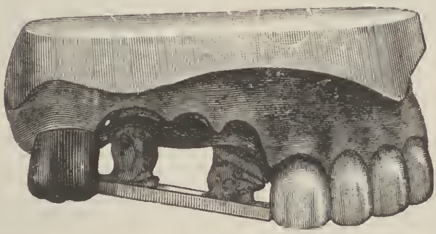


Fig. 330.

as to conform to the gingival outlines and to support the occlusal restoration of each individual pontic, with a minimum of connecting surface between each pontic and each attachment, as illustrated in Fig. 329.

When the adaptation and desired outlines have been secured, the attachments should be placed in position on the abutments, the saddle placed and held firmly in its relation to the mucosa, and an impression taken in plaster.

It is imperative that the saddle should bear firmly against the mucosa while taking the impression. This may be accomplished easily by fitting an orange-stick wedge closely between the respective attachments first, and then forcing the saddle to place with adhesive or base-plate wax, or temporary stopping, as illustrated in Fig. 330.

When the impression, in plaster, has been taken, it should be varnished properly and filled with soldering investment compound. When the cast has been separated from the impression the relationship between attachments and saddle should be sustained permanently by soldering. When attachments and saddle have been joined by soldering, the fixture should be cleaned in the acid bath, replaced in position on the abutments and the final bite and impression taken.

The cast should be made of soldering investment compound and, when mounted upon the articulator, the pontics should be selected and ground to the desired adaptation and relationship with the attachments and to the saddle. The case then should be invested for the final assemblage with solder. The assembling wire should be fitted carefully and the final soldering completed.

The structural requirements and the completed fixture in a typical case involving the application of porcelain, with a saddle, to the construction of posterior fixtures in the upper arch, are illustrated in Fig. 331.

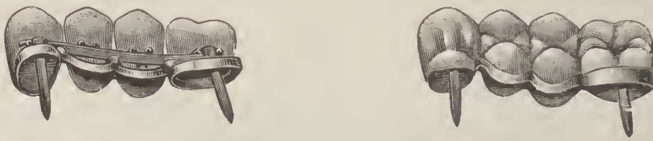


Fig. 331.

Fig. 332.

In the lower arch, all requirements of a saddle, with a more sanitary type of construction, may be obtained frequently by the use of a half-round, or "D" wire of about 12 gage, with the convex surface adapted directly to the summit of the edentulous area between the attachments. The convex surface adapted to the edentulous ridge affords a fairly sanitary result, while the flat surface affords all support necessary to the occlusal surface restoration of the pontics with porcelain.

In the construction of a fixture of this type, the adaptation of the half-round wire may be made with pliers, instead of by swaging, and since the same close adaptation required of a saddle, as applied to the preceding type for the upper arch, is not required of this type in the lower arch, an impression under pressure is not necessary. In fact, the wire, used in this manner and for this purpose, may be adapted and soldered directly upon the first cast. A final impression and cast then will afford opportunity for the adaptation of the pontics, the fitting of the assembling wire, and the final soldering.

The structural requirements and the completed fixture in a typical case, made in this manner, are illustrated in Fig. 332.

Combination Gold and Porcelain Bridgework.

In many instances, the advantages of gold and porcelain may be combined successfully in a single fixture.

Dowel Crowns. Dowel crowns, made with a platinum coping and built of porcelain, may be used successfully as an attachment, in cases where it may be desirable to use pontics of some other type, and to complete the fixture with gold.

In the use of a porcelain dowel crown as an attachment for bridgework, the presentation of a liberal surface of the platinum coping toward

A B

Fig. 333.

the adjacent pontic, or pontics, is necessary as a means of affording ample opportunity for soldering and of insuring adequate strength. This provision is obtained easily by soldering an additional rim of platinum, 28 gage, to the periphery of the basal surface of the coping at the time of soldering the facing. (Fig. 333 A.) The crown then may be completed with porcelain as a single unit (Fig. 333 B), and subsequently assembled to the fixture, as described previously; and in accordance with the requirements and without danger to the porcelain if the usual precautions are observed.

Gold Crowns. Full, or partial telescope crowns, made in gold, may also be used as attachments for porcelain bridgework by building the porcelain part of the fixture to fit them, but independent of them, and subsequently uniting them with solder.

If all other parts of the fixture must be built in porcelain, and must go through the furnace, very little advantage is gained from the use of full telescope crowns made in gold, as platinum would answer the same purpose in most cases; but some advantage may be obtained by the use of partial crowns made in gold in this manner.

When the body of the fixture must be built in porcelain, and when it is desirable to use as an attachment some type of partial crown which

can be made only in gold, the attachments should be made and finished first as single units. The porcelain section then should be made in accordance with the requirements, and constructed to assume the desired relationship with the attachments, and to include in its structural design the presentation of a freely exposed surface of platinum, adequate to the requirements of soldering and of strength, as illustrated in Fig. 334 A.

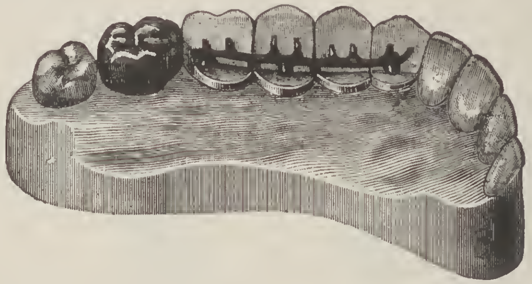


Fig. 334 A.

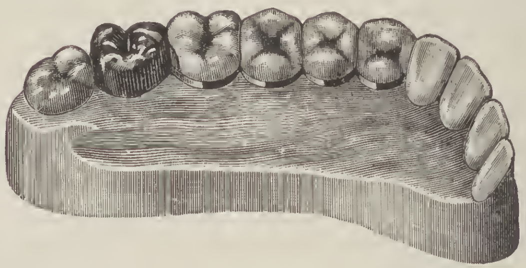


Fig. 334 B.

When this provision has been observed properly and adequately, the porcelain section should be finished separately, after which the relationship between porcelain and gold units, whether full or partial crowns, should be sustained by means of an impression, the cast made with investment compound, the porcelain section further invested and protected properly, the case heated carefully and assembled with solder. (Fig. 334 B.)

Making Porcelain Sections. It is necessary frequently to make porcelain sections, or "gum blocks," particularly in the replacement of missing anterior teeth. In many cases of extensive loss of tissue as a result of the early or premature extraction of the natural teeth, or as a result of surgical procedure, the restoration of lost tissue, as well as the

replacement of missing teeth, is demanded. And when the restoration of lost tissue is demanded, a porcelain section, restoring the lost tissue with gum enamel, is the only means by which a high order of esthetics may be satisfied.

Porcelain sections, with gum enamel restoration, to be used with attachments made in gold, may be built easily and successfully. The attachments to be used in the fixture should be made and finished as single

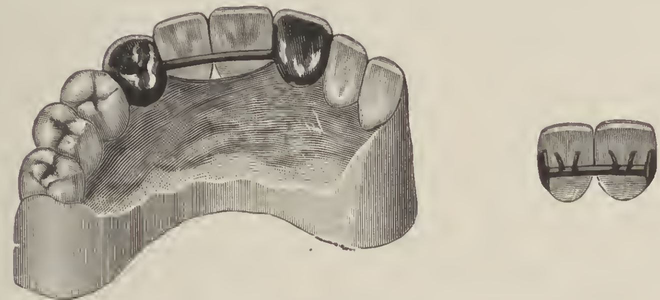


Fig. 335 A.

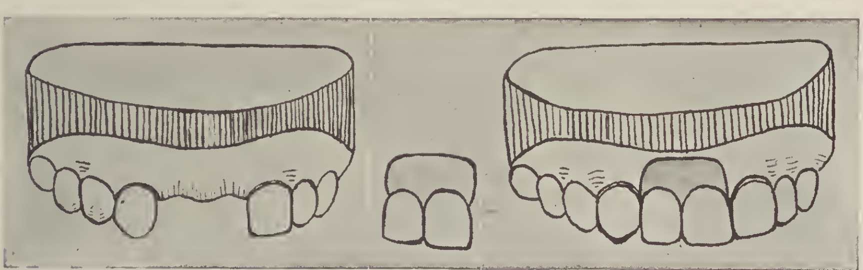


Fig. 335 B.

units first. Then they should be placed in position on the abutments and an impression taken in plaster. A cast made in plaster is here preferable for the reason that it presents a smoother and, therefore, a more accurate surface.

When the cast has been obtained, platinum pin facings of proper size, type and color, should be selected and ground to the adaptation desired. Their relationship should be sustained temporarily with adhesive wax. The labial or buccal surface of the facings then should be covered freely with investment compound in such manner as to sustain the relationship securely, and yet admit of their removal from the plaster cast.

When the investment has crystallized, facings and investment should be detached from the cast. Round iridio-platinum wire, about 16 gage,

should be fitted to a close contact with each facing at the desired point between pins and gingival edge. If contact with all pins does not obtain, each pin should be bent toward the assembling wire until in contact with it. A flange of platinum plate, about 28 gage, then should be fitted to each end of the wire and sustained in contact by the addition of a small bit of investment compound. The case then should be heated thoroughly and each point of contact soldered securely.

When the facings are assembled permanently in this manner, all sharp points and edges of platinum should be rounded nicely and finished smooth. The flanges at the mesial and distal ends of the assembling wire will afford a soldering surface and insure strength in the final assemblage to the attachments with solder. (Fig. 335 A.)

In building the restoration with gum enamel, accuracy of adaptation is obtained by covering this portion of the cast with thin tin foil first, and lubricating the foil with vaseline. The assembled facings then should be placed in position on the cast and the contour and restoration desired made by filling in between the tin foil and over and around the gingival ends of the facings, and over and around the assembling wire and the pins, with porcelain body of a color similar to the color of the facings.

When the desired shape and contour has been obtained, the section should be detached from the cast carefully. Detachment is facilitated by lubricating the tin foil, but should the foil cling to the porcelain body, it should be teased away gently. The section now should be fixed in some form of fire-clay support, placed in the furnace and the added porcelain fused until well but not highly vitrified. All cracks and crevices which present after the primary bake, as a result of shrinkage, should be moistened and a second application of the same body made and fused.

Gum enamel body, of the color desired, now should be applied in sufficient thickness to insure the form and color required. The case then should be fused. Three bakes will be required; more are seldom necessary. Some difficulty may be experienced in procuring a gum enamel body of proper color, but the color desired must be obtained by experimentation and should be satisfactory before using.

When the section has been finished and fitted to the original plaster cast, the attachments then should be removed from this cast, placed in position on the abutments and a final impression taken in plaster. This impression should be poured with investment compound and the resulting cast used for the final assemblage of the section to the attachments with solder, as previously described.

Some idea of the esthetic possibilities obtainable from making porcelain restorations in sections for unusually exacting cases is presented in Fig. 335 B.

Basic Requirements.

In the construction of porcelain bridgework several basic requirements are essential to successful achievement and must be observed. They are as follows:

First: Platinum, or the alloy of iridio-platinum, must be used throughout the building of the superstructure.

Second: All joints must be soldered with 25 per cent. platinum solder, or with pure gold.

Third: If pure gold is used as a solder, it must be fused thoroughly, and fused until alloyed with the platinum.

Fourth: In assembling the fixture, close contact between all parts to be united must obtain.

Fifth: All of the strength required in the finished fixture must exist in the superstructure itself, and no sharp angles should present.

Sixth: Flat-back facings having platinum pins should be used.

Seventh: Porcelain must be used for esthetic purposes only, and must be supported and protected against stress in every direction.

Eighth: The higher-fusing porcelain compounds are strongest and, hence, should be used exclusively.

Ninth: While two and sometimes three bakes are necessary, the desired color, contour and carving, with allowance for shrinkage, should obtain in the primary bake.

Tenth: In placing the piece in the furnace, it should be deposited in the center of the muffle, with all surfaces of porcelain presenting toward the opening.

Principles and Technics of Removable Bridgework.

CHAPTER XVII.

REMOVABLE BRIDGEWORK.

In combining the replacement of missing teeth with tissue restoration, the type of construction known as "removable" bridgework has a distinctive field of usefulness. It affords an opportunity for meeting the highest physiological and sanitary requirements, and demands all of the dental engineering skill and craftsmanship which is called for in the application and construction of fixed bridgework.

Due to the recognized importance of oral hygiene and of the ever increasing demands of prophylaxis, the psychology of removable bridgework is almost magical.

Any effort directed toward, or which will aid in the promotion and maintenance of health is progressive and constructive, and is essential to successful achievements. But removable bridgework is not a panacea for all of the ills attached to the replacement of missing teeth by other methods; nor is it the only rational method of procedure.

Except in edentulous mouths, all methods of replacing lost teeth are but a choice of evils. All require, or result, in more or less injury to the supporting and remaining natural teeth. And the application of removable bridgework demands, primarily, quite as much mutilation, and results eventually in quite as much injury as does any other method. As an intermediary between fixed bridgework and clasp dentures, however, it is a useful mode of procedure.

Removable structures are more sanitary than fixed bridgework, though less efficient in the restoration of function. Yet they are often more efficient and less of a mechanical incumberance than clasp dentures.

Removable bridgework comprises an assemblage of abutment and retaining attachments. It embraces that type of construction, in which the body of the fixture which supports the missing teeth and restores lost tissue, rests firmly upon the edentulous tissues, and is held in position by

means of retaining attachments which are supported by the abutment teeth.

The retaining attachments are agencies through which the structure is retained in position and stabilized when functioning and which also permit of removal and replacement.

This type of construction is not the product of modern development. To a large extent it is the heritage of misapplied and unsuccessful fixed bridgework; the outgrowth of a recognition of the limitations of fixed bridgework and of the ever increasing and more exacting demands of sanitation.

During the evolution of removable bridgework, the art of supplying missing teeth has been "revolutionized" many times by the introduction of "new" forms of retaining attachments. At the time of their introduction, most of them were heralded as revolutionary methods of procedure, applicable universally. Most of them were soon abandoned without seriously retarding the progress of dentistry. Many have been forgotten. None were, or are, applicable universally.

Removable bridgework is a useful method of procedure in proportion as the indications for it are favorable, and as the application may be made skilfully.

But, unless the indications are favorable, and unless all operative and mechanical details of construction are minutely and skilfully executed, removable bridgework will do as much irreparable injury to the supporting teeth and to their investing tissues as will result from the use of any other method of replacing missing teeth.

It is probable that quite as many good teeth have been lost through the indiscriminate and unskilful application of removable structures as have been lost because of similar application of other methods. Hence, notwithstanding its advantages, it is not to be regarded as a universal method of procedure.

Advantages. When used with discrimination, however, and when built and adapted skilfully, removable bridgework possesses many advantageous features, as follows:

First: The replacement of missing teeth may be combined with the restoration of lost tissue in a manner which subscribes to the highest requirements of sanitation.

Second: The normal functioning activity of the abutment teeth is restricted to a minimum extent only.

Third: A minimum of contact with the mucosa and a minimum of mechanical incumberance is required.

The first advantage enumerated is an important consideration, because every opportunity for affording and for insuring sanitation must present in all cases when the replacement of missing teeth and the restoration of lost tissue is demanded.

The second feature is important also for the reason that a more physiologically ideal condition undoubtedly obtains, especially in large fixtures, when the replacement and restoration may be made in a manner which will not interfere appreciably with the normal functioning movement of the supporting teeth.

And the third feature is important because a minimum of mechanical incumbrance is desirable at all times and in all cases.

All of these features may be obtained in the use of well designed, well constructed and well adapted removable bridgework. And, when indicated, no other method of procedure offers quite the same opportunities, or answers quite the same purposes.

Indications. Generally, removable bridgework is indicated whenever fixed bridgework is contraindicated; or, specifically, whenever fixed bridgework is contraindicated, some type of removable structure is demanded.

Clasp dentures might answer the same purpose. Structures of this latter type are simpler, more economical, and require no mutilation of the supporting teeth; but they offer a degree of mechanical incumbrance which is minimized or eliminated entirely by removable bridgework.

The indications for the rational use of removable bridgework embrace the following classes of cases:

First: In cases where the number of missing teeth to be replaced greatly exceeds the number of remaining natural teeth which may be used as abutments.

Second: Where the distribution of abutment teeth is unfavorable to the mechanical requirements of a fixed structure.

Third: Where the restoration of lost tissue demands the use of a saddle, and where the requirements of sanitation demand a removable structure.

Requirements. The successful application of removable bridgework depends, primarily, upon two basic requirements: First, upon the application of sound mechanical principles; and second, upon the development of a high order both of operative and mechanical skill.

If these basic requirements in the composite may not be evidenced at all times, then removable bridgework should not be attempted, because

the operative part of the procedure is equally or even more exacting and cannot be consigned to expert dental laboratory technicians.

Study Casts. A careful study of the composite requirements of each and every case always must precede the selection of the particular method of procedure which is adapted best to each individual case. No two cases are alike and no one method is applicable universally. Hence, in order to make an intelligent selection, study casts which include all of the remaining natural teeth in both arches must be made and used in all cases.

Abutment Teeth. In the replacement of more than two missing teeth and, particularly, in all structures which involve the bilateral or complex type of construction, the selection of the abutment teeth is an important consideration. In all cases the selection must be made carefully, and always with a view of obtaining the maximum degree of efficiency, permanency and comfort in the restoration. To this end, health, stability and favorable distribution are vital factors.

Retaining Attachments. The selection of the type of retaining attachment which is best adapted to the requirements of each case is also an important consideration and must be made carefully.

Since no one type of retaining attachment is applicable universally, an intelligent selection cannot be made without a knowledge of the respective advantages and disadvantages of each type. This knowledge is essential, for the reason that different types of retaining attachments are indicated often in the same structure. Indeed, in the use of two different types of retaining attachments in the same structure, parallelism often may be obtained more easily and with equal stability and sometimes with even greater resistance to stress.

Saddles. Irrespective of the size of the structure, the shape and formation of the saddle and its adaptation to the edentulous tissues are important features in all cases.

Assemblage. The assemblage of the saddle and of the retaining attachments in their proper relationship with the supporting abutments is the most exacting and the most difficult detail on the construction and successful application of removable bridgework.

The stress imposed upon the abutment teeth, the strength of the retaining attachments, and the efficiency of the structure all depend upon the degree of accuracy with which this procedure is executed. Hence, close attention to detail and exactness are demanded at all times.

Retaining Attachments.

Several different types of retaining attachments are used successfully in the construction of removable bridgework. These vary somewhat in design, but all consist of two parts, one of which engages the other. One of these parts is attached securely to the abutment tooth and the other to the removable structure.

All of the various retaining agencies now used may be grouped in two general classes and designated as "vertical" attachments and "horizontal" attachments. They may be so designated because of the relationship which the surfaces of frictional contact bear to the long axes of the supporting teeth.

Requirements. If the highest possibilities of successful removable bridgework are to be attained, the retaining attachments must subscribe to the following requirements:

First: The area of frictional contact of all retaining attachments should be confined within the circumference of the supporting abutment tooth.

Second: The stress assumed by the retaining attachment should be imposed upon the abutment tooth in a line parallel with its long axis.

Third: All retaining attachments must be mutually parallel and must retain the structure by frictional contact, and not by binding one against the other, nor by the displacement of the abutments.

Fourth: Strength adequate to the demands of occlusal stress must exist in all forms of retaining agencies.

Fifth: Some provision, or opportunity for tightening, or for overcoming the loss of frictional contact between the surfaces, by wear, should present always.

Any retaining agency which extends or projects beyond the periphery of the abutment tooth to any appreciable extent acts as a lever of the first class and imposes abnormal stress. And any great degree of abnormal stress, continued indefinitely, will induce absorption and result in failure.

Vertical Attachments.

That class of attachments which may be designated as vertical attachments embraces all types of retaining devices in which the greatest area of frictional contact between the telescoping parts is in a line parallel with the long axis of the supporting tooth.

Three different types of retaining attachments now in use may be placed in this class, as follows:

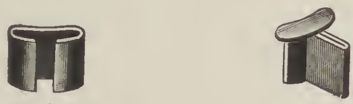
First: That type which consists of a friction plate of some form or shape which engages in a close-fitting, bucco-lingual jacket.

Second: That type which consists of a split-post which engages in a close-fitting seamless tube.

Third: That type which consists of two full crown restorations, one of which telescopes over the other.

Friction Plate and Jacket Attachments.

The type designated as friction plate and jacket retaining attachment is the smallest and the most generally useful retaining device. Several



A B

FIG. 336 A.

FIG. 336 B.

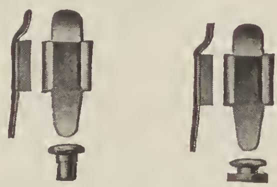


FIG. 336 C.

designs of attachments of this type are used now, and while the shape and form of the friction plate varies somewhat in each type, yet all are similar and all involve the same principle. The friction plate telescopes bucco-lingually into a close fitting jacket. One of the original forms of this type of attachment is illustrated in Fig. 336 A. The jacket is shown in "A," and the friction plate in "B."

One of the more modern types is illustrated in Fig. 336 B, and another type showing a variation in design, and known as the Roach attachment is illustrated in Fig. 336 C.

Indications. Retaining attachments of this type may be used successfully in a large variety of cases. They are made usually in a gradation

of sizes adaptable to the varying dimensions of the crowns of natural teeth and of an alloy of iridio-platinum, or of some other especially hard alloy. Being the smallest type of retaining attachment, they are applicable both to inlay and full crown restorations, and to teeth having vital pulps, as well as to pulpless teeth.

Split-Post and Tube Attachments.

The second type of vertical attachment is known as the split-post and tube attachment. This type consists of a split-post which engages in

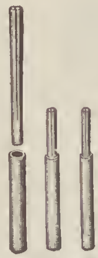


Fig. 337.

Fig. 338.

a closely fitting tube. The post is made by bending a half round or "D" shaped wire over upon itself with the flat surfaces approximating each other and then drawing it down to the size desired, thus forming a "split"-post. The tube is seamless, with one end closed. Both split-post and tube are made of iridio-platinum alloy, the post being especially hard, and are made in sizes of varying diameter. (Fig. 337.)

Indications. Retaining attachments of this type are adaptable to and especially useful in two different classes of cases: First, in those cases in which a pulpless tooth, or root, is used as an abutment; and, second, in cases of assembled abutments.

As applied to the roots of teeth, this type of attachment can be used successfully only in cases where the diameter of the root is sufficiently large to accommodate a split-post and tube of such size as will insure adequate strength. This requirement is essential to the strength both of the supporting root and the removable structure and limits the application almost entirely to the roots of the upper central incisors, cuspids and second bicuspids and to the lower cuspids and bicuspids.

Full Telescoping Crown Attachments.

Full telescoping crown attachments also are a useful type of retaining agency. They consist of a basic coping having axial walls which are slightly inverted from the gingival line to the occlusal angle, and a perfectly flat occlusal surface. The basic coping is to be attached to the supporting natural tooth crown. A full crown restoration which meets all of the requirements of contour and of occlusion is made then to

Fig. 339.

telescope over and fit closely to the basic crown, and this is attached subsequently to the removable fixture.

Indications. This type of retaining attachment is indicated particularly in the restoration of molar teeth where full crown restorations may be used, or may be demanded. It is applicable to teeth having vital pulps as well as to pulpless teeth. Both basic and telescoping restorations which constitute this type of retaining agency are illustrated in Fig. 338.

Horizontal Attachments.

Retaining attachments which belong to that class designated as the horizontal type, differ from those of the vertical type in form and shape, in that the greatest area of frictional contact between the two parts constituting the attachment engages the supporting tooth in a line horizontal with its long axis.

Attachments of this type consist of a friction bar and a close fitting jacket, and the relationship with the supporting abutment tooth necessarily demands that a large portion of the occlusal surface of molar teeth

be involved, the entire occlusal surface of bicuspid teeth and the entire lingual surface of the six anterior teeth, and the mesial or distal, or both the mesial and distal surfaces, to an extent, or depth, sufficient to imbed the attachment within the normal contour of the tooth.

The friction bar may be split or solid. It is attached to the fixture and interlocks into the jacket in such manner as to preclude mesio-distal displacement, while any appreciable degree of bucco-lingual movement is overcome by imbedding the jacket in an inlay or full crown restoration of some type.

Indications. Retaining attachments of this type are useful when the application may be made to pulpless teeth, but have a very limited field of usefulness as applied to teeth having vital pulps. Indeed, any form or type of retaining device which demands pulp destruction, involves procedure which closely approaches the border line of malpractice, and, hence, is of doubtful utility. A typical application of attachments of this type is illustrated in Fig. 339.

Saddles.

In removable bridgework that part of the structure which rests upon the edentulous area, supports the pontics, and affords the means of obtaining the desired restoration of lost tissue, is called the saddle. While this part of a removable structure may be made in vulcanite, the best results, from the combined viewpoints of certainty, accuracy and strength, are obtained from the use of gold or of platinum.

Requirements. Next to the retaining attachments, the saddle is the most essential part of removable bridgework. It must subscribe to the following requirements:

First: It must be adapted closely to and rest firmly upon the subjacent mucosa.

Second: It must be retained securely in its relationship to the mucosa by parallel attachments which engage parallel abutments.

Third: It must cover an area sufficiently large to stabilize the structure.

Fourth: The size and outline will vary with, and must be governed by the number of missing teeth to be replaced.

Fifth: It must not encroach upon the gingival tissues surrounding the abutment, nor upon the adjacent natural teeth.

Sixth: It must be muscle trimmed and present no sharp edges.

Seventh: It should be no thicker, nor heavier, than the requirements of restoration and strength demand.

Vulcanite Saddles. Because of the difficulty of sustaining and maintaining the proper relationship between the attachments and the saddle, no type of vertical, nor horizontal retaining attachment is applicable successfully with vulcanite saddles.

In cases demanding extensive restoration of lost tissue, and, sometimes, for purely economical reasons, vulcanite saddles may be indicated; but when indicated, or when used for any reason, all retaining attachments must be united previously by a basic structure, and in such manner as to insure proper relationship and adequate strength independent of the saddle.

And even then it is necessary further to take every precaution which will insure a maintenance of this relationship on, and with, the cast during flasking, packing and vulcanizing.

Construction.

In the construction of removable bridgework of any type, success or failure will depend largely upon careful technic and absolutely accurate parallelism between the retaining attachments.

Many types of retaining attachments are useful and, to a greater or less extent, special technic is involved in the application of each respective type. But, since no one type is applicable universally, no one line of technical procedure is applicable, likewise, only insofar as basic principles are concerned. It is essential, therefore, that the operator should have a knowledge of basic principles.

Any variations in technical procedure which are applicable only to the particular type of retaining attachment selected are useless as applied to any other type. More or less elaborate instructions are furnished by the manufacturers of each type. Therefore, in the selection and application of retaining attachments to be used, the special technic recommended in their use, should be followed closely.

For these reasons, basic principles, only, as pertain to the application of all types of retaining agencies, in general, and to the requirements of parallelism, in particular, need be considered.

Paralleling Retaining Attachments.

Removable bridgework of any type and structures of any size require two retaining attachments. Seldom more. These may be of the same type or of different types, but absolute parallelism between them must be secured; and absolute parallelism is not obtainable by the eye, alone. Hence, an accurate paralleling instrument must be used at all times and in all cases, irrespective of the type of retaining device used.

A paralleling instrument must be accurate, and to be accurate it must be perfect mechanically. It also must include alinement posts which terminate in an exact reproduction of the friction plate, post, or bar

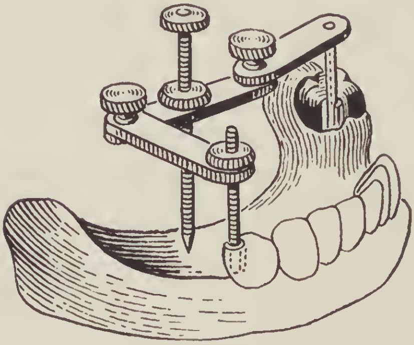


Fig. 340.

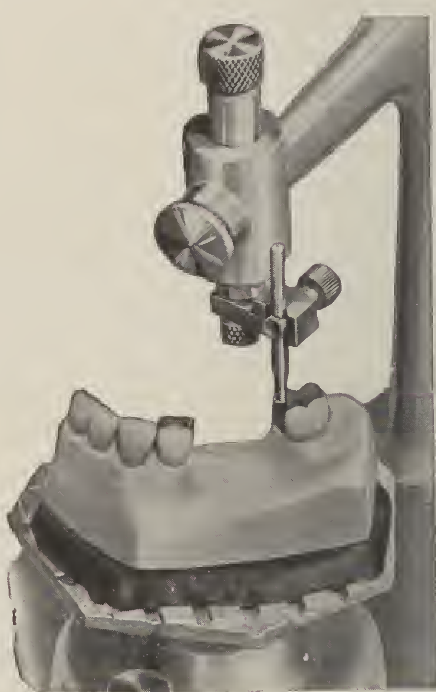


Fig. 341 A.

which constitutes the basic part of all types of retaining device. And these terminals must engage the jackets in exactly the same manner and with all of the accuracy with which the jackets are engaged by the friction plate, post, or bar, itself, except to allow for just enough play to permit of the detachment of one from the other with facility.

Because of the exacting requirements in this connection, no type of retaining attachment can be used successfully, unless an accurate paralleling instrument is provided for or adapted to its special use.

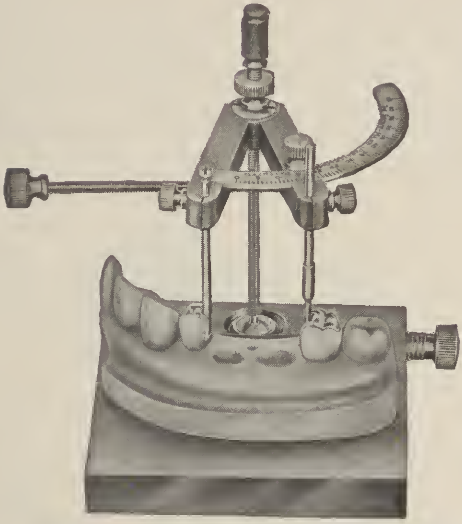


FIG. 341 B.

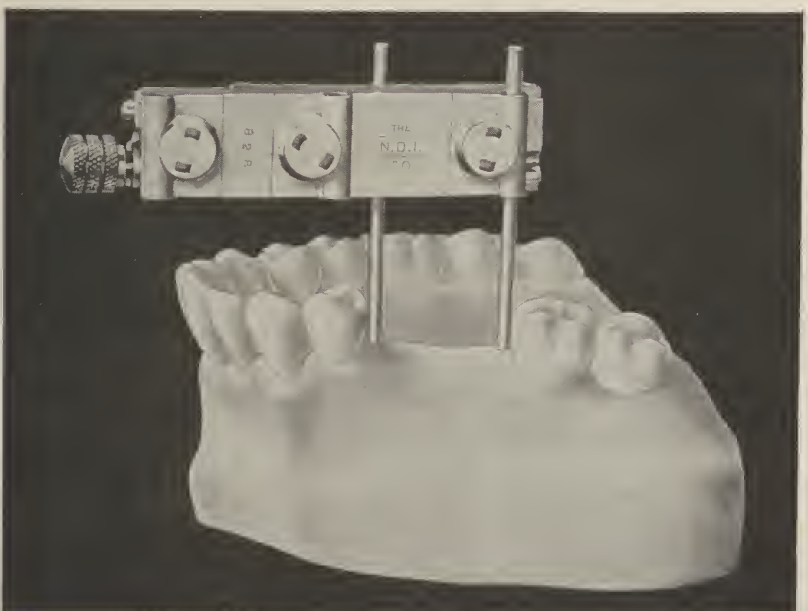


FIG. 341 C.

The simplest form of paralleling instrument, showing its application, is illustrated in Fig. 340. A more mechanically perfect instrument, designed by Dr. L. J. Weinstein, is illustrated in Fig. 341 A. Another known as the Brown-Maier in Fig. 341 B, and the Chayes "parallelometer" in Fig. 341 C. The three latter instruments are accurate, mechanically, and have a wide range of usefulness.

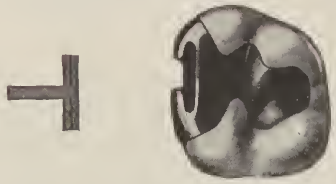
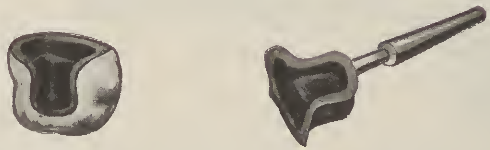


Fig. 342.



A B

Fig. 343.

Application of Vertical Attachments.

Retaining attachments of the vertical type are the most generally useful retaining agencies. Being of the smallest proportions and dimensions consistent with the requirements of strength, they occupy the least space and, hence, are applicable to teeth having vital pulps, as well as to pulpless teeth.

Vertical retaining attachments may be used successfully in connection with inlays, dowel, or full telescope crown restorations.

Inlays. Because of the advantages obtainable from any method of procedure which permits of pulp conservation, the use of retaining attachments of the vertical type, in connection with inlays, offers the greatest range of application and the broadest field of usefulness. (Fig. 342.)

Cavity Preparation. In the application of retaining attachments to inlays, all the basic requirements of cavity preparation, in general, must be observed.

Since the jacket should and must become a component part of the inlay, the cavity must be prepared in such manner and should be of such size as to accommodate the jacket within the circumference of the natural tooth crown, and to insure adequate strength and secure fixation. And adequate strength and secure fixation will not obtain unless the inlay is seated squarely, interlocked mechanically, and supported properly by good, strong cavity walls and margins.

Fig. 344.

Inlays which will accommodate the placement of the jacket for any of the various friction-plate and jacket attachments, and which will permit the jacket to become a component part thereof, may be made successfully and in a simple manner by the use of the indirect method, and by casting, though matrix inlays may be used successfully and in similar manner.

Casting. In making inlays which are to accommodate the retaining jacket by the indirect method and by casting, a shell inlay, only is required. No effort to accurately restore contour need be made primarily.

A shell inlay affords all the accuracy of adaptation to the cavity walls and margins which is demanded and permits of and facilitates the correct placement of the jacket. The restoration of the inlay to the normal outlines and the occlusal requirements of the supporting natural tooth crown

is made subsequently and at the time of attaching the jacket to the shell inlay with solder. In large inlays, such as are possible in pulpless teeth, the jacket and shell inlay may be united and the contour completed by casting, thus obviating an excess of solder. Previous to making the shell

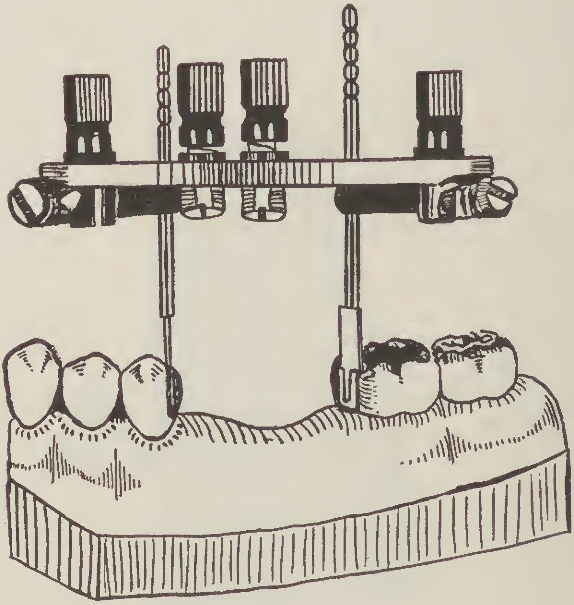


FIG. 345.

inlay, the selection of the retaining attachments to be used must be made and should be of a size proportionate with the dimensions of the crown of the supporting natural tooth.

In the selection of the attachments to be used, it is necessary to make sure that the cavity preparation embraces a bucco-lingual marginal extension which will permit the inlay to accommodate the jacket freely, and without involving or encroaching too closely upon its buccal and lingual margins.

When these features have been observed, a unit impression should be taken in hard impression compound and an amalgam cast made, as described previously. When the amalgam cast has been obtained, the cavo-surface and margins should be lubricated, and a hard casting wax melted and a thin coat painted over all surfaces of the cavity and just slightly overlapping upon all margins. (Fig. 343 A.)

All surplus thickness beyond that sufficient to permit of the attachment of a sprue-former at some convenient point should be trimmed off, observing particularly that accommodation for the jacket exists. This thin shell inlay, then, should be teased loose, the sprue-former attached (Fig. 343 B) and the inlay cast, using a good grade of casting alloy.

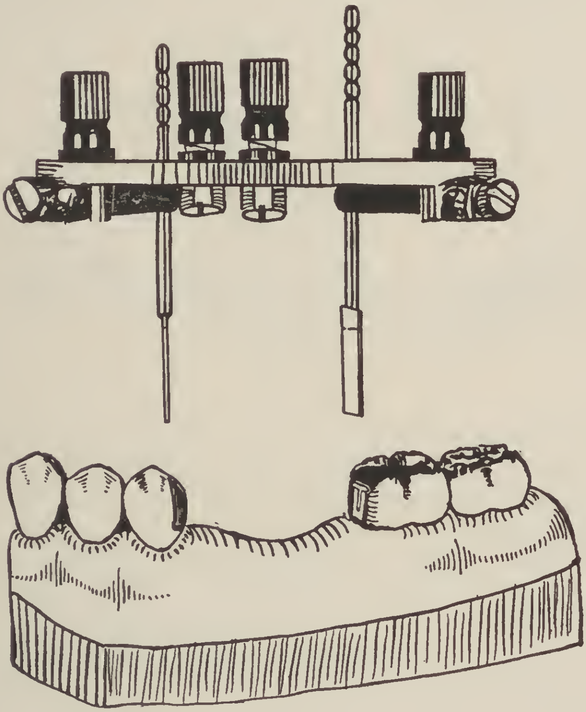


Fig. 346.

After casting, the inlay should be boiled in dilute hydrochloric acid, fitted to position on the amalgam cast and finished to the point of polishing.

When two attachments of the same type are used in one fixture, both shell inlays should be made in similar manner and at the same time. A final adaptation then should be effected directly upon the supporting natural tooth and all margins finished as desired. When the thin shell inlays are completed, they should be placed in position in the supporting natural teeth. (Fig. 344.) An impression then should be taken in plaster.

The inlays should be removed with the impression, but their correct relationship therein must be insured. The impression should be varnished, and then filled, using a high grade of cast-plaster.

When the resulting cast with inlays in position has been obtained, all exposed surfaces of the inlays should be cleaned with alcohol and the jackets of the retaining attachments then adjusted to alinement posts on the paralleling instrument and placed accurately in the inlays. (Fig. 345.) When the adjustment of both jackets and their respective inlays has been obtained with accuracy, the desired relationship between inlays and jackets should be retained securely with adhesive wax. When the wax has been

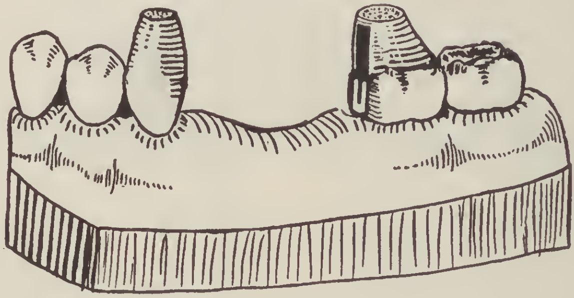


Fig. 347.

chilled with cold water, the alinement posts should be detached carefully. (Fig. 346.) As a means of facilitating this detachment, the terminals of the alinement posts should be lubricated previous to placing the jackets and effecting the adjustment.

With the correct relationship between jackets and inlays retained temporarily with adhesive wax, all exposed surfaces of the inlays should be covered also with wax, as a means of keeping them clean. The relationship now should be retained securely with soldering investment compound and retained in such manner as to insure a preservation of the relationship between inlay and jacket while soldering. This is accomplished in the best manner by filling each jacket carefully with a thin mix of investment compound, first, and then slipping a small wire tack or a slab of slate, or carbon, well down into each jacket, and completing the investment as illustrated in Fig. 347.

The use of a small wire tack is recommended only as a means of insuring the complete filling of the interior of the jacket with investment compound, and of holding it securely in the investment, after inlay and jacket are removed from the cast.

Slabs trimmed from an ordinary slate pencil, heated previously, or from large leads from a lead pencil, and fitted closely into the jackets, also will answer the same purpose, but the complete filling of the interior of the jackets is imperative in all cases.

When invested in the manner indicated, each inlay and jacket should be detached from the plaster cast, and invested as illustrated in Fig. 348.

When the investment has crystallized, the wax should be removed with boiling water, the parts fluxed properly and the case then placed over the flame and heated thoroughly before soldering. The size of the investment and the small area of metal surfaces exposed demands that the case be

Fig. 348.

heated to a high temperature before attempting soldering. Inlay and jacket then are united and all desired contour made with 22 karat solder.

When the soldering has been completed, the inlays should be boiled in dilute hydrochloric acid until all refractory material is removed from the interiors of the jackets, and then finished to the point of polishing. The friction plates then should be lubricated and adjusted to position in the inlays; then they should be placed in position in the supporting teeth and the impression taken and the saddle made.

This method of procedure involves a useful and simple technic which is applicable to any type of friction plate and jacket attachment and accuracy is insured because of obtaining parallelism and contour all at one time and upon one cast.

Matrix Inlays. This same technic also may be followed without casting. The shell inlay may be made by burnishing or swaging a matrix of pure gold, 36 gage, to the amalgam cast and then investing and slightly reinforcing the matrix with 22 karat solder. After reinforcing the matrix the same details of procedure are followed and the same results are obtainable, except that the adaptation of an inlay made with a matrix is not so accurate as is the adaptation of an inlay made by casting.

Direct Method. The direct method may be used successfully in large inlays. Where this method of procedure may be preferable, the

wax pattern should be made in the usual manner. Accommodation for the retaining jacket then may be made in the wax pattern by the use of a round bur, or the suction carving instrument and a sharp carving blade.

If the wax pattern is made of a hard casting wax, and is kept chilled, this procedure may be accomplished with ease and without danger of

FIG. 349.

distortion. When accommodation, even more than adequate has been made, the sprue-former then should be attached at a favorable point and the inlay invested and cast. When the casting has been made, ample accommodation for the jacket should be insured in finishing.

The inlay or inlays then should be finished to the point of polishing, placed in position in the supporting teeth and the impression taken, the cast made, and the jackets alined and adjusted to proper relationship with the inlays and with each other, as described previously in connection with shell inlays, and in the same manner.

"Movable-Removable" Bridgework.

A type of construction designated as "movable-removable" bridgework has been suggested by Dr. H. E. S. Chayes. This type of removable bridgework embraces the application of retaining attachments of the vertical, bucco-lingual type, to inlays, or to artificial crowns, and a saddle formation of original design. (Fig. 349.)

The retaining attachments are made in a variety of sizes, adaptable to both anterior and posterior teeth, and the successful application of the attachments is insured by the use of a mechanically perfect paralleling instrument designed for the purpose, and called a "parallelometer." (Fig. 341 C.)

Dowel Crowns.

Vertical retaining attachments of the friction-plate and jacket type are applicable also to dowel crowns of any type. When used in connection with restorations of this type, the coping should be made in the usual manner and the facing selected, adapted and backed as described

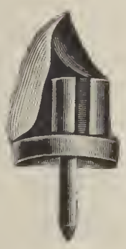


Fig. 350.

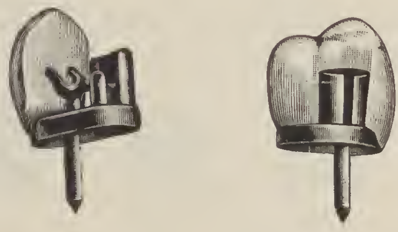


Fig. 351.

previously. Coping and backing then should be invested and united, or tacked together with just enough solder to sustain the relationship.

When the restoration is partially completed in this manner it should be placed in position on the supporting root, together with the other attachment, or attachments, and an impression taken in plaster. The cast then should be poured with soldering investment compound. When the cast has been obtained, the retaining jackets should be adjusted to the paralleling instrument and placed and alined as indicated for inlays. The desired relationship should be sustained with adhesive wax, the alinement posts detached, and the investment made, as already described.

The precaution of using a small tack, or slab of carbon, as a retaining pin and of filling the interior of the jacket completely with the investment material must be observed carefully.

The case then should be heated properly and the relationship between coping and jacket sustained permanently with 22 karat solder. All necessary contouring may be done at this time, also, with solder, or may be done subsequently by casting, though the latter procedure is rarely ever indicated.

A typical dowel crown restoration, with the jacket as a component part and showing the correct position of the jacket in its relation to the coping and facing, is illustrated in Fig. 350.

The same method of procedure is applicable also to dowel-crown restorations made with a platinum coping and flat-back facing, and completed with baked porcelain. The basic requirements and the completed restoration with the jacket as a component part are illustrated in Fig. 351.

Full Telescope Crowns.

Vertical retaining attachments also are applicable to full telescope crown restorations. When used in this connection the band should be made, fitted and contoured in the usual manner. A slot, corresponding with the bucco-lingual dimensions of the jacket, then should be cut out upon the surface which is to receive and accommodate the jacket and into which the jacket should be fitted snugly. (Fig. 352 A.)

A B C

Fig. 352.

Hard casting wax or temporary stopping then should be molded over the basal end of the root, completely filling the interior of the band level with its occlusal edge. The other attachment, or attachments, should be placed in position on their supporting teeth or roots and the bite taken in wax and the impression in plaster. The cast should be poured in hard soldering-investment compound. The bite then is adjusted to place and the cast mounted upon the articulator. When separated, the wax or temporary stopping in the band should be warmed and removed. The band then should be detached carefully from the cast in such manner as to permit of accurate replacement, and care should be exercised to avoid defacing the reproduction of the basal end of the root. When detached, the band should be cleaned in the acid bath and replaced accurately upon the cast.

The retaining jacket then should be alined properly and placed just free of the opposing teeth and its relationship with the band sustained with adhesive wax. When the alinement post has been removed, band and jacket should be detached from the cast and invested. In investing, the jacket should be filled completely with investment compound and the

head of a retaining tack, or a slab of slate, or carbon, slipped down to place, as indicated previously. Just enough investment compound to fill the interior of the band and to hold the retaining tack or slab, and the retaining jacket securely should be used. When this has crystallized, the adhesive wax should be removed with boiling water and the surfaces of jacket and band exposed freely.

The case then should be heated properly and the jacket attached to the band with 22 karat solder. (Fig. 352 B.) When the soldering has been completed, band and jacket should be cleaned in the acid bath, replaced upon the cast and the occlusal surface restoration formed in casting wax, then invested and cast. In investing, it is necessary to observe that the jacket is filled completely with investment compound. The completed restoration is illustrated in Fig. 352 C.

While vertical retaining attachments of this type may be used successfully in combination with full telescope crowns in this manner, they offer no special advantages over a well adapted clasp, especially if the telescope crown is constructed so as to accommodate the clasp without undue enlargement of the circumferential dimensions.

Application of Split-Post and Tube Attachments.

Split-post and tube attachments are useful retaining devices. They are indicated in two classes of cases: First, in cases where the natural crown has been sacrificed previously, or must be sacrificed, to the gingival line; and second, in cases of assembled abutments where extensive restoration of lost tissue is demanded.

As applied to the roots of teeth, split-post and tube attachments are used in combination with dowel-crown restorations, and are indicated only in cases where the dimensions of the root are favorable, as stated previously.

In the construction of dowel crowns in which a split-post and tube are to be used as a retaining agency, a coping which includes a full or partial band should be made and adapted in the usual manner, except that the tube instead of the split-post is attached to the floor of the coping. Before attaching the tube to the floor of the coping permanently by soldering, proper alinement and parallelism with the other attachment or attachments must be secured.

Accurate parallelism between the supporting root, the tube and the coping, and the other attachment or attachments used, is difficult and exacting, but is possible, provided that a properly adapted paralleling instrument is used, and may be obtained by observing the following method of procedure:

When the coping has been completed, the canal should be enlarged to receive and accommodate the tube freely. It should be enlarged to the fullest extent possible without weakening the root unnecessarily. The floor of the coping then should be perforated immediately over the center of the enlarged canal.

As a means of facilitating soldering and of insuring strength in the union of the coping and tube subsequently, care must be exercised in ob-

FIG. 353.

FIG. 354.

serving that the perforation through the floor is not larger in diameter than the diameter of the tube. Each tube then should be placed in position in its canal, and the terminals of the paralleling instrument lubricated with vaseline and introduced into the tubes to the full depth.

With both tubes thus alined and held in position, the impression should be taken in plaster. Tubes and copings, together with the paralleling instrument, will be removed with the impression, and it must be observed that they are in their proper relation. (Fig. 353.)

The cast then should be made of soldering investment compound. When the cast has been obtained, and the terminals of the paralleling instrument detached, carbon points, made by trimming down an ordinary

lead pencil, should be fitted closely and introduced into the tubes to their full depth, allowing some surplus to project.

Parallelism between tubes and copings is then made permanent by soldering directly upon the cast. When the relationship between tubes and copings has been made permanent by soldering, the surplus ends of the tubes should be cut away with a thin-edge stone until nearly flush with

FIG. 355.

FIG. 356.

the floor of the coping. The completed coping which is to be attached to the supporting tooth is illustrated in Fig. 354.

This basic coping then is placed in position upon the root and a dowel-crown restoration embracing a partial telescoping band, together with the split-post as a dowel, is made in the usual manner as a single unit, and in accordance with the requirements of the case. (Fig. 355.)

Application of Telescoping Crown Attachments.

As applied to molar teeth telescoping crowns are one of the most useful retaining attachments for removable bridgework. This type of attachment consists of two parts, a basic coping, and a telescoping coping, both of which must be made for the individual case. It is used extensively by Dr. F. A. Peeso, and is constructed as follows: When the supporting

tooth has been prepared as indicated in Fig. 356 A, the measurement is taken, and a band is made of 28 gage, 22 karat, or coin gold. In cutting the band, the edges should be cut at an angle which will make the circumference of the occlusal edge smaller than the gingival edge. (Fig. 356 B.) The band should then be made in circular form and soldered, using a minimum of solder. It should then be trimmed and fitted to the supporting tooth. When fitted to meet the requirements, the occlusal edge should be adapted closely to the axial walls, and trimmed flush with the occlusal surface. A floor of the same karat and thickness of gold should be attached with a minimum of solder. (Fig. 356 C.) The surplus should be trimmed away, and the basic coping thus formed, finished and fitted to position on the tooth.

When adapted satisfactorily, the basic coping should be removed and its interior painted with a thin coating of melted wax. A piece of heavy paper, cut previously to the size desired, should now be wrapped around the coping in such manner as to form a matrix for a handle, and should be tied with a ligature. A low fusing, fusible alloy should then be melted and poured into the coping and paper matrix. Painting the interior of the coping with melted wax will prevent contamination with the fusible alloy, and facilitate the removal of the coping subsequently.

When the fusible alloy has cooled, the paper matrix should be removed. The basic coping then presents as shown in Fig. 356 D. A measurement of the gingival edge should now be taken, and the telescoping band made and fitted in exactly the same manner as was followed previously in making the basic band. When fitted to place over the basic coping, the occlusal edge should be flush with this edge of the coping, but the gingival edge should be a trifle shorter, as illustrated in Fig. 356, E. A floor now should be attached, and the telescoping coping completed. (Fig. 356 F.)

The basic coping now should be warmed slightly over a flame and removed from the fusible alloy. Both basic and telescoping copings should then be placed in position on the supporting tooth, a bite and impression taken, and the cast made and mounted upon an articulator. The restoration of contour should be made with casting wax, by applying it to the basic coping either in melted or in plastic form. When the contour required and the carving desired have been completed, the wax restoration then should be teased loose, and removed from the telescoping coping. (Fig. 356 G.)

The sprue-former should now be adjusted to position and the wax restoration invested and cast. When the casting has been made and finished, it should be attached to the telescoping coping with a small bit

of solder applied around the gingival edge. The completed telescoping restoration is illustrated in Fig. 356 H.

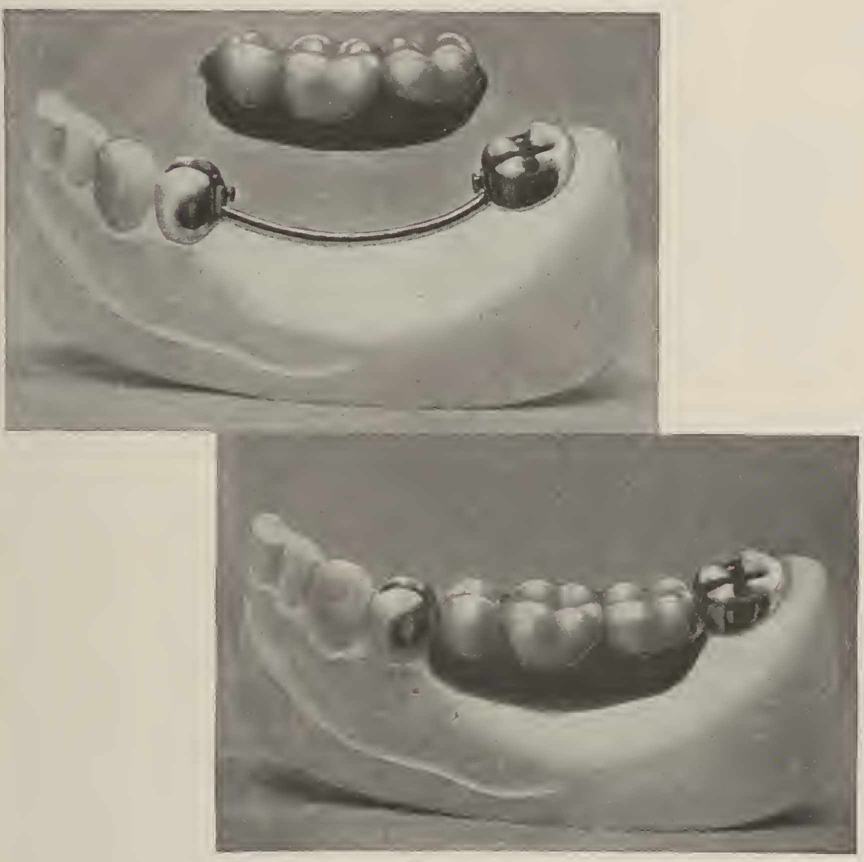


Fig. 357.

For the reason that better results and greater accuracy are obtainable by making the casting separately and attaching it with solder subsequently, no effort should be made to cast the restoration directly to the telescoping coping.

Assembled Abutments.

The application of split-post and tube attachments is not limited to the roots of teeth alone, but may be made successfully in many classes of cases. It is a particularly useful type of retaining attachment in cases

of assembled abutments, and in cases demanding extensive or abnormal restoration.

The assemblage of abutment teeth consists in obtaining attachment to two or more teeth and in uniting these attachments with a basic structure which rests upon the mucosa and which is cemented to place as a single unit. The replacement of missing teeth and the restoration of lost tissue

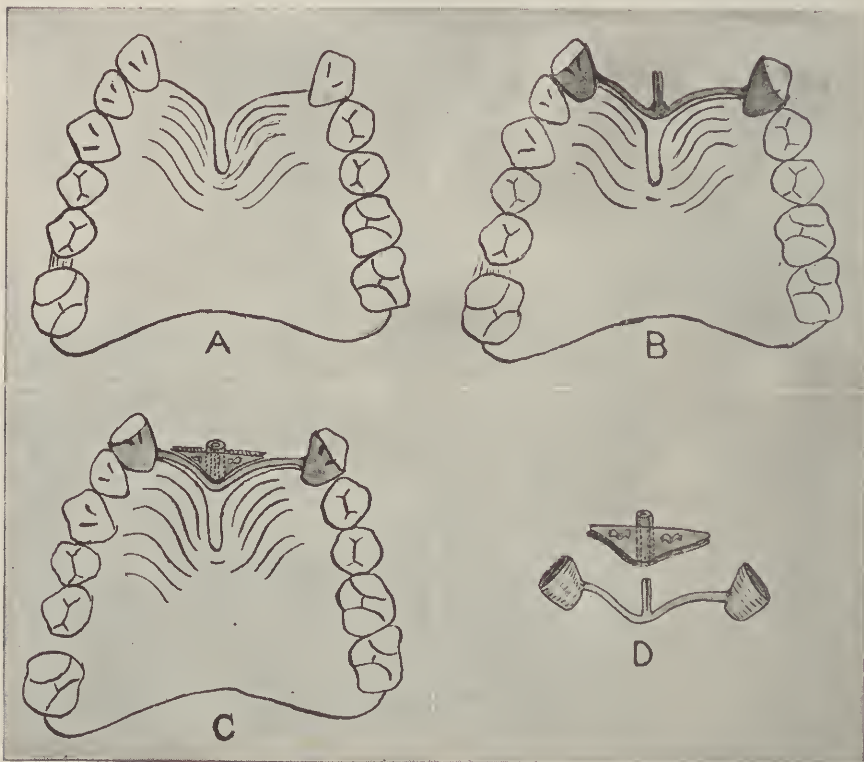


FIG. 358.

then is made in the form of a removable structure which is retained in position by means of the basic structure with which the abutments have been assembled.

Indications. The assemblage of abutment teeth is a useful method of procedure in some cases, but it is a procedure which does not subscribe to the highest requirements of sanitation. It is indicated in two general classes of cases only:

First: In cases where one or the other or all of the teeth which it

may be desirable to use as abutments have become loosened in their attachment to the investing tissues, with no absolute pathological condition existing, and where their retention is desirable. By means of assembling

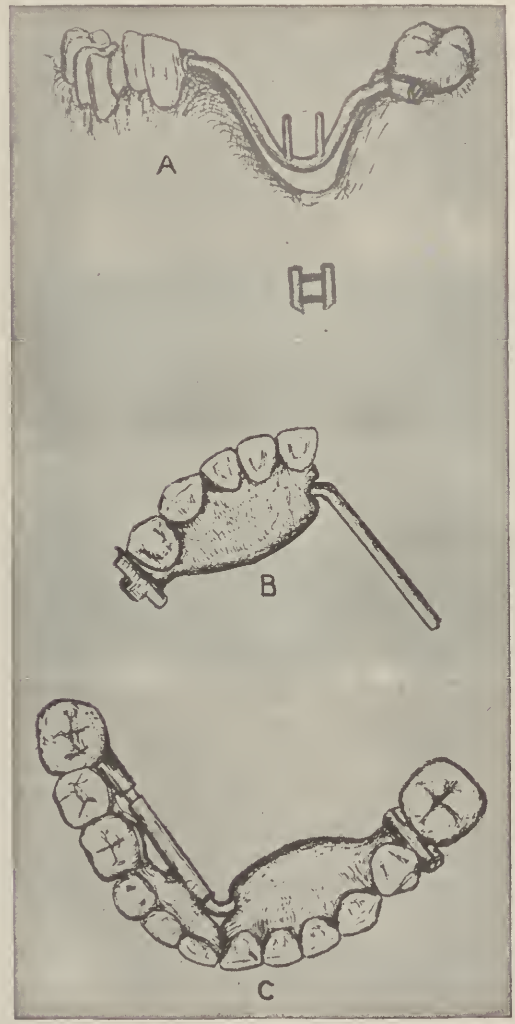


Fig. 359.

them one with the other, health may be promoted and many years of usefulness may be obtained by stabilizing them, or by placing them in a state of partial rest.

The somewhat prevalent opinion to the effect that if a tooth is sufficiently loose to require stabilizing, it is sufficiently loose to be lost, is not confirmed by clinical observation and is not entirely rational, unless an extreme pathological condition exists.

A typical case of assembled abutments, showing the application of the Roach attachment, used in connection with inlays having a partial peripheral band, and where considerable tissue restorations is required, is illustrated in Fig. 357.

Second: In cases demanding extensive restoration of lost tissue, and where it is not advisable, or may not be possible to have a fixture of any type rest upon the edentulous tissue.

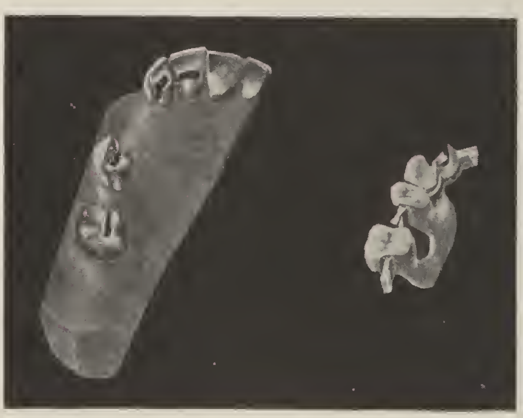


FIG. 360.

A typical case of this class, involving the assemblage of the abutments and the successful application of a single split-post and tube attachment and an extensive restoration, is illustrated in Fig. 358 A.

In many cases of cleft palate, or of extensive surgical procedure, the abutment teeth often may be good, sound and free from pathological lesions, and yet not firm. In such cases several years of usefulness may be obtained from their assemblage and partial fixation, even in the simplest manner.

In this particular case, simple, open-face crowns, made of 28 gage platinum, were adapted to the abutments and assembled with a round, iridio-platinum wire, 14 gage. A split-post was attached securely to the center of the assembling wire by soldering. (Fig. 358 B.) Retaining plates, made of 28 gage, 22 karat gold plate, were attached to the tube labially and lingually and trimmed to follow the outline of the assembled

wire. (Fig. 358 C.) These retaining plates serve the purpose of affording attachment of the tube to vulcanite (Fig. 358 D), of which the restoration was made.

Another more extensive case, typically illustrative, and indicating the usefulness of assembled abutments and of split-post and tube attachments, and demanding an extensive restoration, is illustrated in Fig. 359 A. In this case the restoration involved the replacement of a segment of the mandible lost through accident. The assembling bar, designed by Dr. Calvin S. Case, ingeniously sustained the normal relation of the mandibular fragments and yet permitted a rotary movement upon the right side and a hinge movement upon the left side. It was made of round iridio-platinum wire, 12 gage, to the center of which two split-posts were paralleled and soldered. (Fig. 359 B.) The tubes then were united and a removable fixture built around them in vulcanite. (Fig. 359 C.)

Application of Horizontal Attachments.

As indicated previously, horizontal attachments embrace that type of attachment which consists of an interlocking friction bar and jacket in which the greatest area of frictional contact is mesio-distal and in a line horizontal with the long axis of the supporting tooth.

Indications. Attachments of this type are applicable to inlays, dowel crowns or full telescope crown restorations and to anterior, as well as posterior teeth, but afford no especially advantageous features.

Indeed, the depth to which horizontal attachments must be imbedded in the supporting teeth in order to insure adequate strength and stability, usually demands pulp destruction; and when pulp destruction is required, the rational application of any type of retaining attachment is limited. The general indications for the use of attachments of this type, therefore, embrace only teeth which are already pulpless.

Attachments of this type are made for the individual case and the design and size of the friction bar vary accordingly. Usually a split-bar is used and is made by bending over upon itself a piece of flattened iridio-platinum wire, of a size and shape adapted to the requirements of the case, and then shaping and forming it as desired. To preclude mesio-distal movement, the free end of the friction bar is always bent in such manner as to interlock in its jacket.

An open jacket then is made to fit three surfaces of the friction bar, using thin platinum or pure gold, about 36 gage, for the purpose. As in the case of split-post and tube attachments, the split-bar permits of tightening.

The placing, the alinement and the bucco-lingual paralleling of attachments of this type, whether used in connection with inlays, or dowel, or full telescope-crown restorations, are made upon the cast then with an observation of all precautions and careful technic indicated previously both for vertical and split-post and tube attachments. This type of retaining attachment is used extensively by Dr. C. F. Ash. A typical application is illustrated in Fig. 360.

Fig. 361 A.

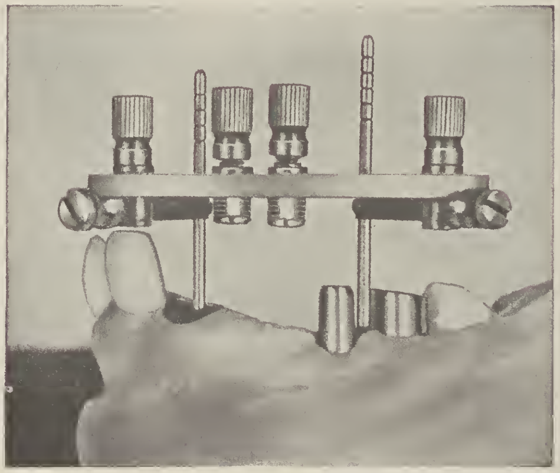


Fig. 361 B.

Combining Retaining Attachments of Different Types.

The use of two different types of attachments is indicated frequently if the selection is made with discrimination and if the particular types best adapted to the case at hand are wisely selected. Indeed, the use of two different types is often advantageous, insuring greater stability than would obtain from the use of two attachments of the same type.

Indications. As an illustration: A cuspid root and a cavity involving the occluso-mesial surfaces of a first molar, with the bicuspids missing,

would provide indications typical for the use of a split-post and tube attachment upon the cuspid root, and a horizontal attachment resting in a gold inlay in the molar, as illustrated in Fig. 361 A.

In the use of attachments of different types in the same fixture, however, the requirements of adaptation and of mutual parallelism do not differ essentially and must be met with the same precautions and with the same careful technic that would be utilized in the employment of attachments of the same type, as indicated previously. (Fig. 361 B.)

Construction of Saddles.

The saddle is an important component part of removable bridgework. Its function is to sustain the relationship of the retaining attachments, stabilize the fixture, support the pontics, and afford opportunity for the artificial restoration of lost tissue.

The first requirement incident to the construction of the saddle is an accurate impression. The second is an accurate cast. When the retaining attachments have been completed as single units, all refractory materials should be removed from the interiors of the jackets and the friction plate, tube, or bar, lubricated with oil or vaseline and adjusted to its proper position in each jacket. The completed attachments then should be placed in position in the supporting abutments and an impression taken in plaster.

When the impression has been obtained, the retaining attachments should be removed from the abutments and placed accurately in the impression. The latter then should be varnished and poured, using a good grade of cast plaster. Plaster is used for the reason that it affords smoother and more perfect surface outlines.

When the cast, with the attachments in position, has been obtained, the saddle should be designed and the outlines traced with an indelible pencil. The surface of the cast at this point then should be depressed slightly by scraping.

The design of the saddle is an important feature. The requirements, as previously indicated, should be observed carefully.

In small, unilateral fixtures the general design, originally suggested by Dr. H. E. S. Chayes, meets the physiological and mechanical requirements favorably and offers a minimum of mechanical incumbrance. When restoration is demanded, the size of the saddle must be increased proportionately; and in bilateral maxillary fixtures, the outline should be fitted in and around the rugæ in such manner as to minimize mechanical incumbrance. When the design has been determined and outlined on the cast, the saddle may be made either by casting or by making dies and swaging.

Casting. The casting process offers the most simple, expedient and accurate means of making the saddle. Saddles made by casting are stronger.

In making saddles by the casting method, the cast first should be lubricated with thin oil. Thin sheet casting wax, which is prepared especially for this purpose, then should be made plastic by dipping in warm water and molded over the cast, using pledgets of cotton, also dipped in warm water, to conform it to the surface of the cast closely. The wax pattern then should be trimmed to follow the outlines indicated on the cast, and to fit the exposed surfaces of the friction plate, tube, or bar in such manner as to facilitate their attachment to the finished saddle, subsequently, by soldering.

Pontics.

The type of pontics to be used in the case must be considered at this time. In small fixtures involving one, two or three pontics, where but little, if any, restoration of lost tissue is demanded, the use of some type

Fig. 362.

of all-porcelain pontic affords the most esthetic and sanitary results. In the use of pontics of this type, the bite must be taken previous to taking the impression and the casts must be mounted upon the articulator.

All-Porcelain Pontics. Several types of all-porcelain pontics are used. These include the "Trubridge" (Fig. 362) and Ash and Sons all-porcelain tube teeth, the Goslee tooth, and diatoric bicuspids and molars.

Wherever tube teeth may be used as pontics, their use affords the most typical reproduction of natural tooth form; hence the most esthetic results. In their use the selection as to size, color and type should be made with care.

When the selection has been made and the requirements of adaptation and of occlusion have been met, the central retaining hole should be filled with plaster; or this may be done before grinding. The basal end of each pontic then should be lubricated with thin oil, after which it should be placed in position on the wax pattern and its relationship sustained with

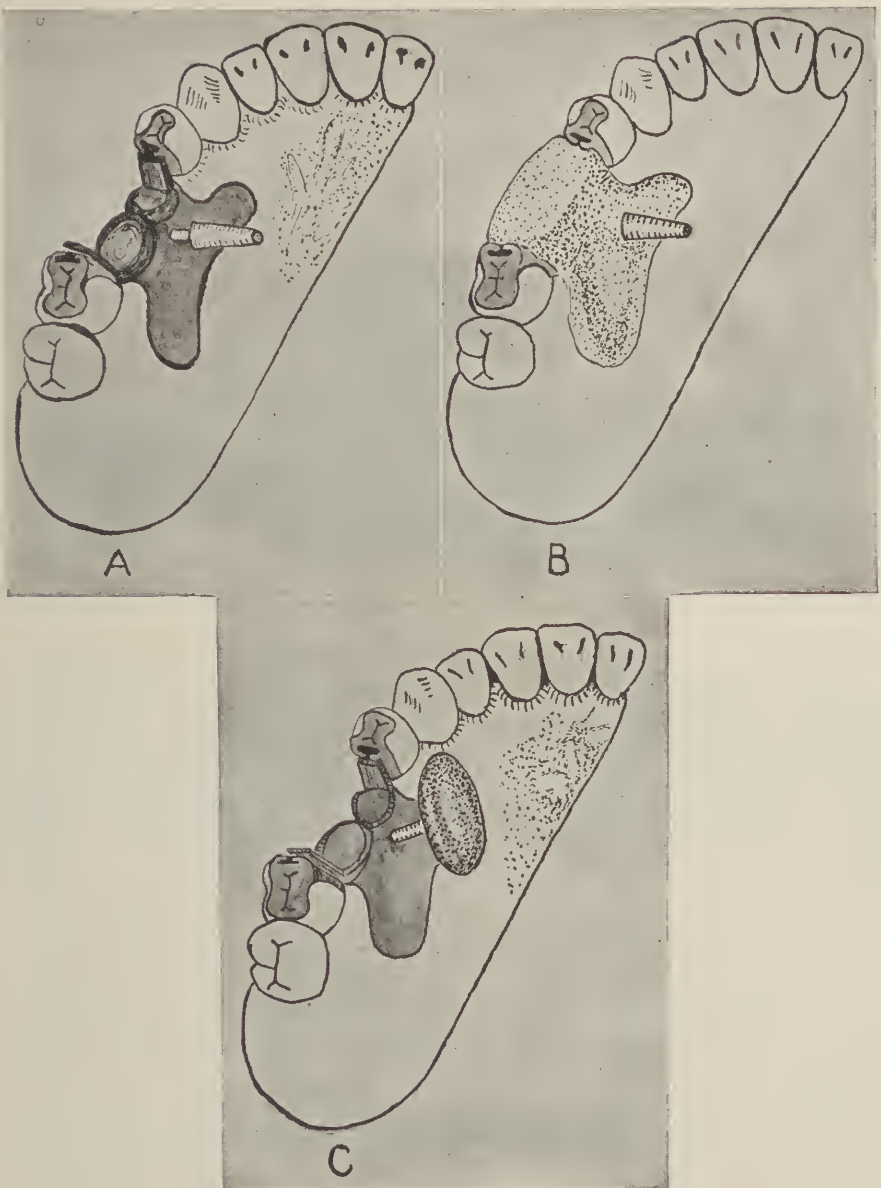


FIG. 363.

melted wax. When all pontics have been assembled in this manner and when the assemblage meets all requirements, the basal end of each pontic

should be housed nicely with melted casting wax and the pattern reenforced and contoured, as desired.

The pontics then should be detached carefully and the sprue-former attached securely at a point relatively near the center of the pattern. (Fig. 363 A.) The entire surface of the saddle then should be wiped clean with acetone, using a small brush or pledget of cotton, and then covered carefully with a thin layer of casting investment compound. This should be painted over the surface with a small brush as a means of avoid-

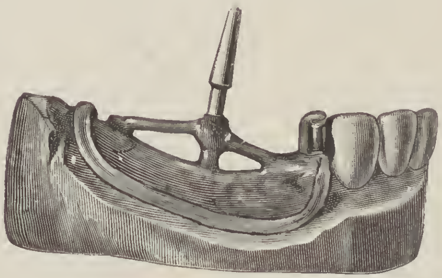


Fig. 364 A.

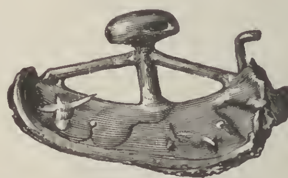


Fig. 364 B.

ing confined air. Any confined air would result in imperfections in the casting. This layer of investment compound should be sufficiently heavy to insure a preservation of the shape and form of the wax pattern, and the sprue-former, of course, must be left exposed. (Fig. 363 B.)

The partially invested pattern should be detached carefully from the cast, submerged in cold water, placed in the base of the flask, the investment completed, burned out, and the casting made. (Fig. 363 C.)

The same method of procedure should be followed in the use of diatoric, Goslee, or similar types of porcelain teeth as pontics, except that in the use of teeth of this type, each pontic should be backed separately with pure gold, 36 gage, previous to final adjustment to the wax pattern. This precaution is necessary at all times, and in all cases, as a means of securing the relationship of the retaining post and of insuring accuracy of adaptation in the casting.

When backings for pontics of this type have been adapted closely and trimmed to the outlines desired, a perforation should be made immediately over the retaining hole and a retaining post of proper diameter fitted, allowing some slight surplus to project beyond the surface of the backing. The relationship between backing and retaining post should be secured with adhesive wax and the two then removed from the pontic, invested, and united with solder. Any unnecessary surplus of retaining post then

should be cut off, allowing just sufficient surplus to insure strength to remain, as illustrated previously in Fig. 300 A.

When each pontic has been backed in this manner, all should be placed in position on the wax pattern, assembled properly, and the necessary contouring and reenforcement of the pattern made with casting wax. The pontics then should be removed and the investment and casting made as indicated previously for tube teeth, and in the same manner.

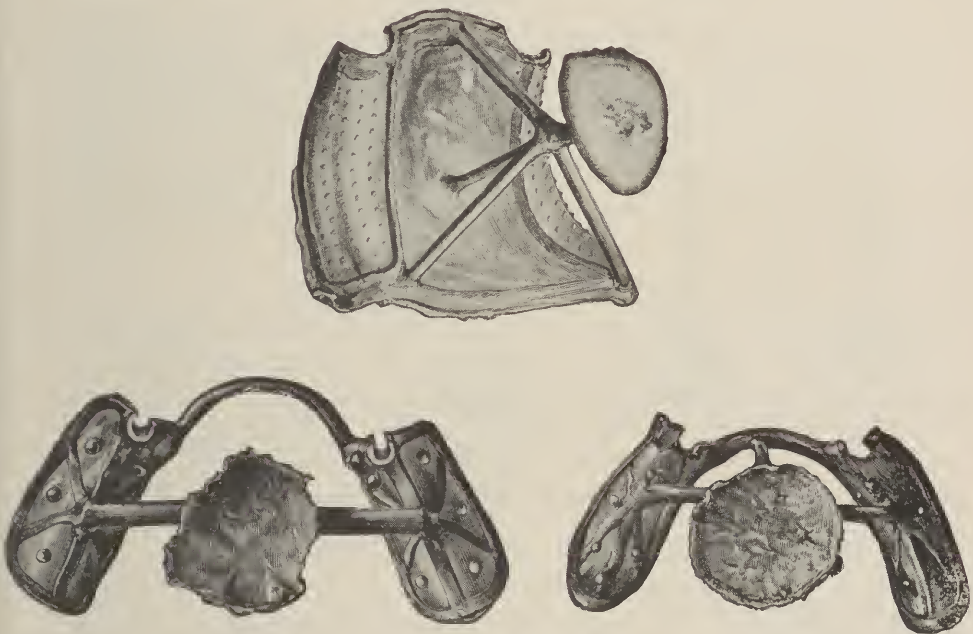


Fig. 364 C.

Artificial Restoration of Lost Tissue.

Where the artificial restoration of lost tissue is demanded to any appreciable extent, either porcelain or vulcanite must be used.

Since it is not feasible and usually not possible to subject retaining attachments to the heat required to fuse porcelain compounds, if all-porcelain restorations are demanded, they must be made separately and united subsequently. Restorations made in vulcanite, however, usually will subscribe to all requirements and answer all purposes.

In making saddles where vulcanite restoration is demanded, the saddle should cover a somewhat greater area of the mucosa and the exact design and outlines should be determined and indicated on the cast.

The wax pattern should be formed on the cast and in the same manner, but should include thicker and more rounding edges and should provide for a secure and adequate mechanical attachment of the vulcanite, all of which may be provided for in the wax. The sprue-former should be attached (Fig. 364 A), and the investment and casting made. (Fig. 364 B.) Larger castings of this type are illustrated in Fig. 364 C.

Swaging.

In making the saddle the swaging process offers no advantages whatever over casting, and while good results are obtainable by swaging, this method of procedure is indicated only in cases where the size of the saddle may make casting difficult, or in the absence of facilities for casting.

In making dies for swaging saddles, low-fusing alloys may be used for small structures, but when of large size the best results will obtain from the use of a die made of Babbitt metal, or zinc, with a counter-die of tin and lead.

In swaging, the surfaces of the dies should be oiled and 22 karat, 28 gage, gold plate should be used. In small unilateral structures one thickness usually will be sufficient, but in larger, or in bilateral structures, reenforcement, adequate to the requirements of strength must be made. Such reenforcement should be obtained by swaging a second saddle of 30 or 32 gage, somewhat smaller in outline and uniting the two with 22 karat or 20 karat solder, or by the use of clasp metal, or wire, adapted closely and attached with solder.

When the saddle has been made by either method, and made in accordance with the requirements, it should be boiled in the acid bath and finished. It is ready then for the attachment of the retaining agencies by soldering.

Assembling.

The greatest possible care must be exercised in assembling the saddle and the retaining agencies. When the saddle has been completed, the retaining attachments should be placed in position on the supporting teeth and the final adaptation and adjustment of the saddle to the retaining attachments and to the mucosa made. An impression which will transfer this relationship to the laboratory accurately then should be taken in plaster.

The saddle should be forced and held in its relationship with the mucosa gently, but firmly, previous to and at the time of taking the impression. A close adaptation of the saddle to the mucosa in the finished structure would not obtain if the assemblage of the saddle and the attach-

ments were to be made directly upon the original cast upon which the saddle was made. Nor will it obtain unless this feature of gentle but firm pressure is observed at the time of taking the impression.

In small structures the best results are to be had by holding the saddle firmly with the fingers and placing just a small quantity of plaster over and around each attachment separately, and removing and soldering each

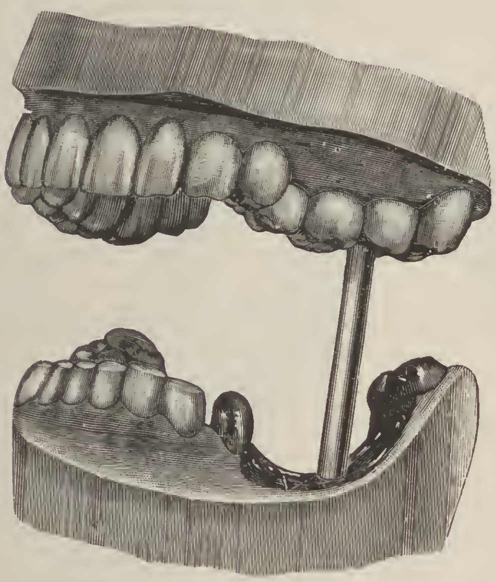


Fig. 365 A.

Fig. 365 B.

attachment separately. In this procedure the saddle is held firmly with the finger, and the plaster is carried to place on the end of a spatula and plastered over and around the saddle and the attachment, using only enough to insure strength. The saddle and the attachment usually will be removed with the impression.

It is rarely ever safe to attempt to solder the saddle to the friction plate, post or bar while in position in the jacket, but is always better and safer to separate the retaining attachment, and then carefully replace the friction plate, post or bar in the impression. If, for any reason, the parts should be reversed, the same precaution applies. The impression then should be varnished and poured, using an exceedingly hard soldering-investment compound. Care should be exercised in separating and, when separated, all exposed surfaces of saddle and retaining attachment should be cleaned thoroughly and fluxed properly. The case then should be heated and the parts united with 22 karat or 20 karat solder.

The same procedure then should be followed in obtaining the relationship and in effecting the assemblage of the remaining attachment or attachments. While it is safer usually to effect the assemblage of each retaining attachment to the saddle separately and in this manner, it is not an imperative method of procedure. Other means of applying moderate pressure upon the saddle may be observed and the relationship between the saddle and both or all retaining attachments may be obtained with a single impression.

Fig. 366.

In small structures, adequate pressure upon the saddle may be secured by the use of a wedge made from an orangewood stick and base-plate wax, or temporary stopping, as indicated previously in Fig. 330. Or, in larger structures, mandibular pressure often may be used successfully and to advantage.

In the application of mandibular pressure, a stick of orangewood should be cut to a length which will permit one end to rest firmly upon the saddle, relatively near its center, and the other end to rest upon the

opposing teeth, as illustrated in Fig. 365 A. If the opposing teeth are absent, one end may be cushioned with impression compound so as to rest upon the mucosa and permit of pressure without discomfort, as illustrated in Fig. 365 B. With the retaining attachments and saddle in position, the impression may be taken in a specially prepared tray (Fig. 366) with gentle, but firm, mandibular pressure upon the saddle by means of the orangewood stick. In the insertion of the impression, the slot in the tray will straddle the orangewood stick and permit the proper placement of the impression.

When the impression has been obtained by either method of procedure, the retaining attachments should be removed and detached as indicated previously and for the same reasons. The friction plate, post or bar then should be replaced, the impression varnished and the cast made as indicated.

When the assemblage of all retaining attachments has been completed, the fixture should be cleaned in the acid bath and fitted to position upon the supporting abutments. When the adjustment is satisfactory, the pontics should be attached.

Attachment of Pontics.

When tube teeth have been used as pontics, the plaster with which the retaining holes were filled previously should be removed. Each pontic then should be placed in position on the structure and the retaining post adjusted and attached to the saddle. Iridio-platinum or clasp-metal wire of relatively the same diameter as the diameter of the retaining hole is used for the retaining post.

In effecting the adjustment and attachment of the retaining post to the saddle, a length of wire somewhat longer than necessary should be cut. One end should be painted with lamp-black mixed with glycerin. With the pontic in its proper position, this end of the post should be introduced into the retaining hole and passed through the pontic until in contact with the saddle. The lamp-black will leave an imprint.

The pontic now should be removed and a hole of the diameter of the retaining post then drilled through the saddle at this point. The pontic then should be replaced in position on the saddle and the retaining post inserted and forced through pontic and saddle until its surplus end projects through the saddle. The relationship between the saddle and the retaining post then should be sustained securely with adhesive wax.

When the retaining post for each pontic has been attached to the saddle in this manner, the pontics should be removed and the structure invested.

The investment should be made in such manner as to leave exposed only that surface of the saddle which rests upon the mucosa.

When the investment has crystallized, the adhesive wax used to sustain the retaining posts should be removed with boiling water, each joint fluxed and the case heated and the retaining posts attached to the saddle with a small bit of 22 karat or 20 karat solder. After soldering, the surplus end of the retaining posts should be cut away and the fixture cleaned in the acid bath and then finished and polished, after which the pontics should be cemented to place.

When the retaining posts constitute a part of the casting, as indicated in the use of all other types of all-porcelain pontics, as soon as the assemblage of the retaining attachments and the saddle has been completed and the structure finished and polished, the pontics should be cemented to place.

Use of Replaceable Facings as Pontics.

When replaceable facings are to be used as pontics, as soon as the retaining attachments have been assembled to the saddle and the relationship of the structure and its attachments to the supporting abutments has been proved correct, structure and attachments should be placed in position on the abutments, the bite taken in wax and the impression in plaster.

The abutment part of the attachments should be detached and placed aside and the impression then varnished and filled with high-grade investment compound. The bite should be adjusted and the case mounted upon the articulator.

Facings and backings now should be selected and adapted to the requirements. The relationship between the backings and the saddle then should be sustained with adhesive wax and the facings removed. Before sustaining the relationship it is well to make sure that each facing may be detached easily from its backing. When the desired relationship has been sustained securely and all facings removed, the cast then should be detached from the articulator, submerged in cold water, and the relationship secured with investment compound, using only enough to cover and protect the backings and to insure strength. When the investment has crystallized, the wax should be removed with boiling water, the surfaces of the saddle and backings fluxed properly and the case then heated and the assemblage and contour made with 20 karat solder. The same procedure applies also to the use of posterior pontics of the replaceable type.

Vulcanite Restoration.

In structures demanding restoration of lost tissue, and where the saddle has been made with provisions for the use of vulcanite, the structure should be adjusted to position on the supporting abutments when the assemblage of the retaining attachments and the saddle has been made in the manner indicated. The bite then should be taken in base-plate wax and the impression in plaster.

When the cast has been obtained and mounted upon the articulator, vulcanite pontics should be selected and adapted to the requirements. The required restoration then should be made with wax, the case flasked, packed, vulcanized, and finished as usual.

Fig. 367.

Vulcanite Saddles. When, for economical or other reasons, the entire saddle is to be made of vulcanite, accurate and reliable results will not be obtained unless the retaining attachments are assembled previously; and assembled in such manner as to insure a preservation of their relationship during the procedures incident to flasking, packing and vulcanizing.

Where the structure is to be made entirely in vulcanite, the retaining attachments should be placed in position in the abutment teeth, the impression taken in plaster and the cast made in investment compound in the manner indicated.

The relationship between the attachments then should be sustained by uniting them with clasp-metal wire of a size which will insure strength in their assemblage, independently of the vulcanite. The assembling wire should be adapted in such manner as to be completely imbedded in the vulcanite, and yet not interfere with the placement of the pontics. Round clasp-metal wire, 14 gage to 16 gage is used for this purpose. (Fig. 367.)

When the retaining attachments are assembled thus, they should be placed in position on the abutment teeth and the bite taken in pink base-plate wax and the impression taken in plaster. The cast then should be made in plaster and mounted upon the articulator. The pontics now

should be selected and adapted and the saddle and restoration required made with wax. The case then should be completed in the usual manner, as described for vulcanite work.

Cementing Retaining Attachments to Abutments.

In all types of removable bridgework, that part of the retaining agency which is to be attached permanently to the supporting natural tooth should not be cemented to place finally until both, or all, of the retaining attachments have been assembled securely, and their correct relationship proved.

Irrespective of the fact that parallelism was obtained in seating the retaining agencies in their attachments to the supporting abutment teeth originally, it is advantageous to defer the final mounting until after the assemblage of the basic structure. As soon as the retaining attachments have been assembled with the saddle, or united with an assembling wire, however, and the correct relationship proved, the attachments may be cemented to the abutments.

This procedure may be followed with the greatest degree of accuracy and certainty by assembling the structure and all of its attachments first, and then cementing it as a single unit. When cemented, the removable structure should not be disturbed until ample time for complete crystallization of the cement has been allowed. Any danger of uniting the retaining agencies may be overcome by attaching them with melted wax previous to cementing.

When the attachments are cemented previous to the attachment of the pontics with vulcanite, the fixture should be removed and replaced several times before the bite and impression are taken.

Summary.

All types of retaining agencies, except clasps, consist of two parts, one of which engages the other closely. One part is attached to the supporting abutment in a fixed manner. The other is attached to the removable structure. Their relationship is sustained by frictional contact between the closely interrelated telescoping surfaces.

Manufactured attachments are made in steel dies and are perfect mechanically. Mechanically perfect attachments are essential to the successful application of removable structure. Therefore, in the use of retaining agencies of any type, every precaution to insure preservation of close interrelationship between the telescoping surfaces must be observed at all times.

The friction plate, post or bar never must be bent, indented, nor defaced in any manner and the interiors of the jackets and tubes must be kept clean and free from refractory materials. Throughout the construction of removable bridgework, therefore, the telescoping surfaces of both parts of retaining agencies must be protected.

Fig. 368.

The interiors of jackets and tubes may be kept free from solder only by filling them carefully before soldering. A slate pencil heated to a cherry-red and trimmed to fit; graphite, from a lead pencil, trimmed to fit; crocus, cement, whiting, plaster, or any heat-withstanding oxidizing agent, which is removed easily by boiling in acid, will answer this purpose.

No field of dental effort offers so many diversified methods nor demands more exacting operative procedure, nor more exacting mechanical and technical training than does the successful application and construction of removable bridgework.

All methods of procedure and all methods of attachment have a field of usefulness. None are applicable universally. None may be used to the exclusion of all others.

Precautions.

In the replacement of but one or two missing teeth by means of removable bridgework, exceedingly small structures should be avoided. An element of danger from swallowing small structures enters into their insertion, and while such a mishap is unusual, it is nevertheless possible, as illustrated in Fig. 368.

Principles and Technics of Clasp Denture Construction

CHAPTER XVIII.

CLASP DENTURES.

Clasps were the original retaining agencies, and clasp dentures antedated all methods of mechanically retaining removable restorations in the replacement of missing teeth in partially edentulous cases.

A clasp denture, therefore, is simply another and simpler form of removable bridgework, and when more than three or four teeth are to be replaced in a single structure, well designed and well made clasp dentures are still the most generally applicable, useful, efficient and economical method of procedure.

The application of clasps as retaining agencies for partial restorations probably antedated the advent of vulcanite as a base, but since this time clasps of some type have been in general use, and quite as many types have been suggested and used as have been suggested and used as retaining agencies for removable bridgework.

The primitive type of clasp was made by bending small round, or half round wire to partially encircle the crown of the supporting natural tooth, and then forming a loop for the purpose of affording attachment for vulcanite. (Fig. 369.)

As an evidence that some injury to the natural crown of the supporting tooth followed the use of this simple form of clasp, as a result of abrasion, and that some effort to diminish or eliminate the devastating influence of abrasion must be made, the introduction of the Bonwill clasp followed. This type of clasp was made of heavy gold plate, and provided with an occlusal rest, and was undoubtedly the progenitor of modern clasps. (Fig. 370.)

In the replacement of missing teeth in partial restorations clasps serve as retaining agencies by virtue of resilient arms which partially encircle and grasp the circumference of the crowns of the supporting natural teeth and are retained by frictional contact.

Advantages. The use of clasps as retaining agencies affords three distinctively advantageous features: First, retention of the restoration without mutilation of the supporting tooth; second, simplicity of application and construction; third, economy.

Retention. In all forms of partial denture restorations, efficiency and comfort are increased in proportion to the degree of fixation. But as the structure increases in size, in order that it may meet the demands of replacement and restoration, it must be removable. This is essential

FIG. 369.

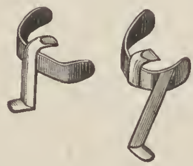


FIG. 370.

because of the requirements of sanitation. Hence, if natural tooth structure and pulp vitality are to be conserved at all times, any method of obtaining fixation which will at the same time permit of removal and replacement without requiring immediate mutilation of the supporting tooth crown, has a wide range of application and usefulness.

It is true that any type of clasp eventually will do more or less injury to the supporting natural crown, irrespective of however perfectly, or imperfectly, it may fit. Still, many years of usefulness as a retaining agent may be afforded before serious injury develops, while immediate injury in the form of more or less extensive mutilation is required in the application of all other types of retaining agencies now used. The application of clasps, therefore, is often the lesser evil for this reason.

Simplicity. The simplicity of technic involved in the application and with which accuracy of adaptation may obtain, together with the less exacting demands of parallelism made possible by the proper formation of the resilient arms, cause clasps to be more generally and more successfully applicable in the hands of the greater number. And any method which involves a simplicity of technic, insuring successful application in the hands of the greatest number, is always a useful and valuable procedure.

Economy. The successful application of some of the more complex

types of retaining agencies necessarily involves an expenditure of time which makes the cost of production prohibitive in many cases.

The time required and the initial cost in the application of clasps are reduced to a minimum. This affords an economical advantage which places clasp fixtures within the reach of all.

Indications. The use of clasps as retaining agencies in partial-denture restorations is indicated generally in the following classes of cases:

First: When a removable type of fixation is preferable or necessary.

Second: In all cases where any immediate mutilation of the crowns of supporting natural teeth is undesirable.

Third: Wherever the number of missing teeth to be replaced greatly exceeds the number of abutment teeth.

Fourth: When the distribution of the abutment teeth is unfavorable to the application of any other type of retaining agent.

Fifth: When the shape and the inclination of the natural crowns of the abutment teeth are favorable to the adaptation and mechanical retention of the resilient arms of a clasp.

Sixth: When normal stability of the abutment teeth does not obtain, and, hence, when the use of some simple form of retaining agent is demanded.

Application. The successful application of clasps as retaining agencies will depend, primarily, upon the adaptation of the resilient arms to the circumference of the crowns of the supporting natural teeth. Hence, the shape and contour of the crowns of the natural teeth which are to support clasps must be favorable.

Bicuspids and Molars. For this reason, successful application is limited chiefly to bicuspid and molar teeth, and when confined to the bicuspid and molar teeth, success and usefulness are usually insured.

And whenever clasps may be adapted to and used in connection with full telescope-crown restorations (a particularly ideal application), the maximum of usefulness and of permanency obtains and is insured.

Cuspids. Clasps may be adapted to the crowns of cuspid teeth and often may serve successfully as retaining attachments when applied thereto; but the natural shape and form of the cuspid teeth is not favorable, primarily, to the secure retention of clasps. Hence, when the application to cuspid teeth must be made, too much must not be expected.

Incisors. The natural formation of the crowns of the incisor teeth is still more unfavorable to the successful application of clasps as retain-

ing agents. The usefulness of clasps as applied to the incisor teeth, therefore, is negative and the application is contraindicated in all cases.

Requirements.

In the successful application of clasps as retaining agencies, they must subscribe, primarily, and in a general way, to the following requirements:

First: A clasp must consist of a rigid center and two resilient arms.

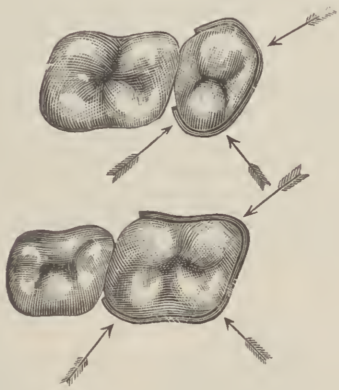


Fig. 371.

Second: It must be made of an alloy which possesses both tensile strength and resiliency.

Third: In order that its relationship may be retained firmly by frictional contact, it must encircle at least three angles of the circumference of the crown of the supporting natural tooth. (Fig. 371.)

Fourth: Its width should not be greater than necessary to insure sufficient surface contact to sustain relationship.

Fifth: It should be well adapted to the surfaces of the natural crown with which it comes in contact.

Sixth: It should be provided with an occlusal or lingual rest which will sustain its relationship, diminish abrasion, and prevent any subsequent settlement of the structure which it supports.

Seventh: It should not encroach upon the gingival tissues, nor interfere with occlusion.

Eighth: It should not displace the supporting abutments, nor be retained by binding one against another.

Ninth: It should be attached to the structure securely, but not necessarily rigidly, at a point relatively near its center. And in order that resiliency may be effective, both arms must be free from contact with the structure itself.

Tenth: All edges should be rounded and smooth, and all surfaces well polished in order that no irritation may be offered.

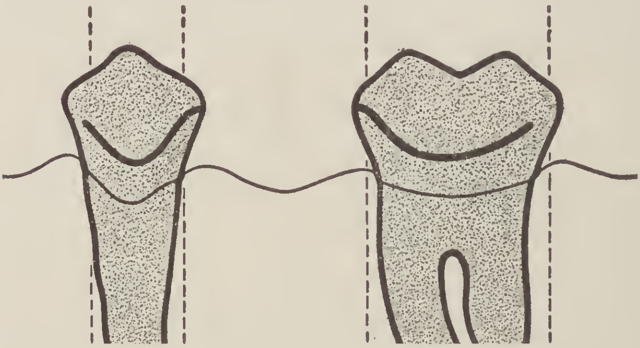


FIG. 372 A.

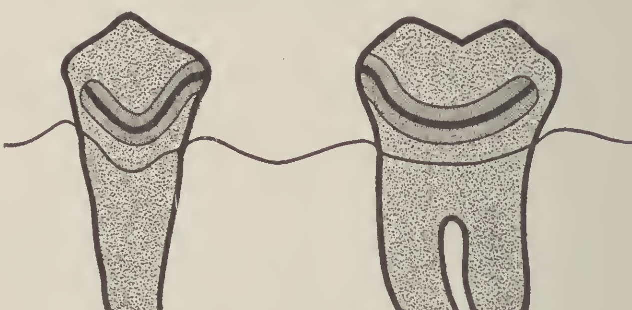


FIG. 372 B.

Efficiency of Clasps as Retaining Agencies.

The efficiency of clasps, as retaining agencies, will depend entirely upon the relationship which they bear to the crowns of the supporting teeth.

In order that a clasp may grasp the supporting tooth crown and may be retained in its relationship thereto, the central part, which is made rigid subsequently by its attachment to the structure, must never be extended gingivally beyond the height of contour of the natural crown; but

its two resilient arms must completely engage and extend gingivally slightly beyond the greatest circumference.

Height of Contour. An analytical study of tooth surfaces will disclose that a definite conformation has been provided by Nature, with the object of affording a protection to the environing soft tissues. A view from the occlusal surfaces of all teeth discloses a slanting plane leading away from the gingiva. As soon as this plane has been extended far enough to overhang the gingiva, the plane rapidly turns or slants back,

Fig. 373.

rootward, or towards the gingiva. The first or upper plane is long, and the second or receding plane is quite short. Just at the juncture of these two planes is what is known as the "height of contour." We cannot speak of this as the "greatest circumference" of the tooth, because it is not a straight line, but follows accurately the festoon of the gingiva.

It is imperative that the height of contour of the natural tooth crown should be located on the cast before designing the outlines of the clasp (Fig. 372 A), and that all abnormal inclinations and variations should be observed closely. Efficiency will depend more upon the position of the clasp in its relationship to height of contour of the supporting crown than upon the amount of actual contact surface. An adaptation thus made as illustrated in Fig. 372 B.

Precision instruments have been designed for the purpose of locating the height of contour and measuring and charting all variations from the normal in the inclinations of the supporting teeth, and are useful in designing clasps to accommodate these variations.

Any limited variations from the vertical which may present between two or more supporting teeth, either mesio-distally or bucco-lingually, if divided evenly in designing the clasp, will greatly increase clasp efficiency and decrease the stress imposed upon the supporting abutments.

Correct relationship of clasps which are adapted properly to the natural crowns of the supporting teeth is illustrated in Fig. 373.

Selection of Abutment Teeth.

In the application and construction of clasp dentures, the abutment teeth which are adapted best to the requirements and to the successful retention of the structure should be selected carefully.

The natural tendency of the teeth to migrate toward the edentulous area results frequently in a mesial or distal inclination from the vertical to a degree which, in many instances, would preclude the successful use of such teeth as abutments. The teeth selected to support clasps, therefore, should be as nearly vertical as possible and as nearly parallel as possible one with the other. Any great variation from relatively vertical and parallel lines must be noted and accommodated in the construction of the clasps.

Two clasps usually are adequate to the requirements of fixation for any single structure. In bilateral structure the abutment teeth should be as nearly opposite each other as possible. In extensive cases where many teeth are to be replaced, where only a few abutments remain, and where the distribution of the abutments is not favorable to the secure mechanical retention of the structure, the use of three, and, perhaps, even four clasps may be indicated sometimes; but this is to be determined only by the application of sound mechanical principles and by the stability of the abutments.

The selection of the abutment teeth and the construction of clasps to meet the requirements will be facilitated by the use of study casts in all cases, and the outlines of the arms of the clasps in their relation to the crown of the supporting tooth should be determined and traced with an indelible pencil.

Construction of Clasps.

The construction of clasps should follow the selection of the teeth to be used as abutments. Two types of clasps are used, wrought clasps and cast clasps. Several methods of procedure are followed in the construction of each type.

Wrought Clasps. Previous to the advent of the casting process, wrought clasps, made by adapting heavy clasp-metal plate, 24 to 26 gage, to conform to the desired outlines in relation to the crown of the support-

ing natural tooth, were used exclusively. Clasps made in this manner are still used successfully and are indicated frequently.

While it is true that the casting process offers opportunities for obtaining greater accuracy of adaptation than is possible by bending heavy clasp-metal plate, it is questionable whether absolute accuracy of adaptation in clasps which are retained in their relationship to the natural crown of the supporting tooth by frictional contact is an advantage.

FIG. 374.

In this connection it is noteworthy that well-constructed wrought clasps, which are wide and which fit closely but not accurately, cause the development of less hypersensitiveness in teeth having vital pulps; also they possess greater tensile strength. Therefore, they are less likely to become brittle and break than are cast clasps.

If an exceedingly close adaptation of the clasp to the natural crown of a tooth having a vital pulp increases the deleterious influence of abrasion and promotes hypersensitiveness, which clinical observation seems to indicate, this feature, together with that of greater resiliency and greater tensile strength, indicate a permanent field of usefulness for wrought clasps.

In any event, the use of wrought clasps is indicated, especially upon bicuspid and molar teeth in all cases where a maximum of resiliency and of tensile strength is demanded; and particularly in all cases where the supporting teeth are not overfirm in their attachment to the investing tissues.

The adaptation of wrought clasps may be obtained in the best manner by taking a unit impression in impression compound first and then making an amalgam cast. When the cast has been obtained a piece of clasp-metal plate, 24 to 26 gage, should be cut to the proper dimensions and annealed

thoroughly. Annealing is accomplished best by heating to a cherry red and plunging in alcohol.

With pliers of favorable shape the clasp then should be bent to conform closely to that surface of the reproduction of the natural crown which presents toward the edentulous space. The arms then should be adapted to the buccal and lingual surfaces and trimmed to follow the outlines traced previously on the study cast.

FIG. 375.

When the adaptation and outlines desired obtain, an occlusal rest made of the same gage of clasp-metal should be fitted and attached with solder. If additional strength in the arms is required, they may be reenforced by fitting first a strip of clasp-metal of the same gage, but much narrower, to the center of each arm and then uniting the reenforcement to the clasp with 22 karat or 20 karat solder. In both instances the relationship may be sustained with small pointed soldering pliers, and without an investment, although an investment may be used, if the operator prefers.

When occlusal rest and all necessary reenforcement has been provided, the clasp then should be fitted closely to the amalgam cast (Fig. 374) and then finished to the point of polishing.

The reenforcement of the arms may be made with solder alone, but the use of solder alone destroys the resiliency of the alloy and makes the clasp brittle.

A more accurate adaptation of the clasp may be obtained by burnishing pure gold, about 36 gage, to the cast first, with a generous surplus, and then fitting the clasp-metal over it and subsequently uniting the two with solder. But, as indicated previously, a closer adaptation than is obtainable by conforming the clasp metal directly upon the amalgam cast is of doubtful advantage.

While the amalgam cast made from a single unit impression, taken in impression compound, is not an accurate reproduction of the natural tooth crown, it is sufficiently accurate for the purpose of making a wrought

Fig. 376.

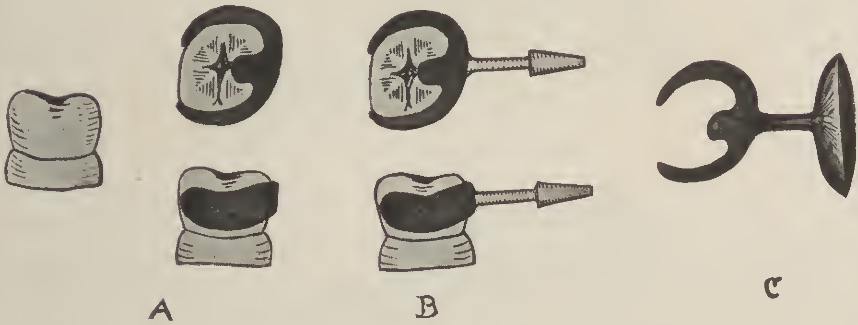


Fig. 377.

clasp, in which absolute accuracy of adaptation is not desired, for the reasons mentioned.

If preferable, the unit impression may be taken in plaster and the cast made with any of the low-heat fusible alloys. In making the cast of fusible alloy, the impression should be dried thoroughly and then closed at each end with moldine, or with plaster, and the fusible alloy poured when cool. (Fig. 375.) Or the impression may be taken in hard impression compound if the cast is poured with a low-fusing alloy which may be used with impression compound.

If wrought clasps are to be used on cuspids, half-round clasp-metal wire, 14 to 16 gage, should be used instead of plate, and a typical type of construction which may be used successfully, as applied to cuspid teeth, is illustrated in Fig. 376. Clasps which are to be adapted to cuspids, however, probably are made best by casting.

Cast Clasps. Cast clasps are indicated whenever accuracy of adapta-

tion is demanded or is desirable. Several different methods of procedure are followed in the construction of clasps by the casting process.

Simple Method. The simplest method of procedure involves taking a unit impression in impression compound and making an amalgam cast of the natural tooth crown. When the cast has been obtained it is lubricated with thin oil and the clasp formed to the desired outlines and thickness

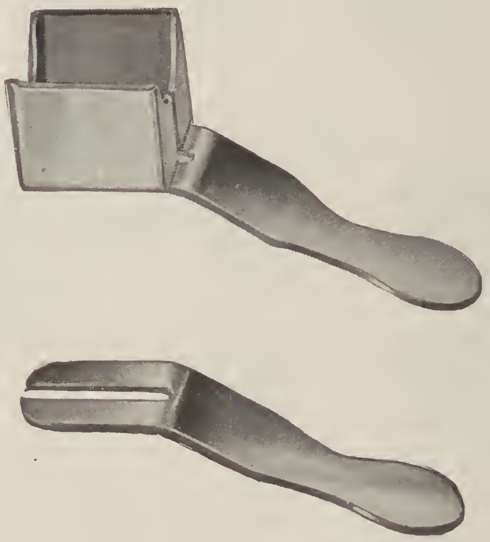


Fig. 378.

with melted casting wax. (Fig. 377 A.) The wax clasp then is loosened, the sprue-former attached (Fig. 377 B) and the investment and casting made. (Fig. 377 C.)

A unit impression taken in this manner does not insure a cast which is an absolutely accurate reproduction of the natural tooth crown, but where the natural tooth crown is of typical normal formation, sufficient accuracy to insure a well-adapted clasp obtains.

In designing and forming the clasp on the amalgam cast, the study cast should be used as a guide in all cases.

Where greater accuracy than is afforded by this simple method of procedure is desired, an absolutely accurate and exact reproduction of the natural tooth crown must obtain.

To obtain an exact reproduction of the natural tooth crown the impression must be taken in sections, and in plaster. This is accomplished

easily by the use of a separable impression tray, a convenient form of which is illustrated in Fig. 378.

Two different methods of procedure are followed. One may be termed the direct method and the other the indirect method.

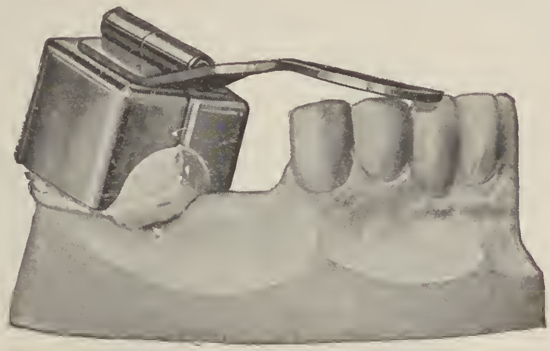


Fig. 379.

A

B

Fig. 380.

Direct Method. In the procedure which may be designated as the direct method, the technic followed by Dr. F. E. Roach is productive of successful and reliable results. In this procedure the separable impression tray is coated with vaseline and filled with what is known commercially as "Complaster," and the impression taken. (Fig. 379.) When the complaster has crystallized the tray handle should be removed and the impression divided into two lateral halves by the insertion of a sharp pointed instrument into the joint.

When divided and removed (Fig. 380 A), the two lateral halves of the impression should be placed in apposition again by closing the tray and inserting the tray handle. (Fig. 380 B.) The impression then should be varnished with liquid silex and filled with a casting investment compound which becomes especially hard after crystallizing.

Fig. 381.

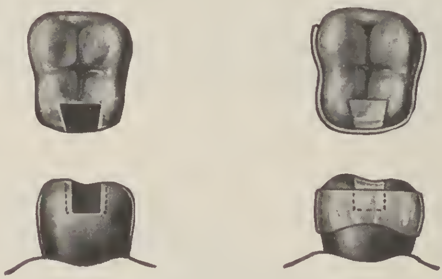


Fig. 382.

When the cast has crystallized it should be placed in water, heated gradually and boiled until the complaster impression has been disssolved completely, leaving a clean, sharp cast.

The clasp then should be formed directly upon the cast and to the outlines and thickness desired with melted casting wax. (Fig. 381.) The sprue-former then should be attached securely, the cast submerged in cold water and the investment and casting made.

Indirect Method. In the procedure which may be designated as the indirect method, the technic suggested by Dr. N. B. Nesbett is useful and reliable. In this procedure a plaster impression is taken, using a separable impression tray. When separated, removed, and the two lateral halves again brought into apposition, the impression should be varnished, using shellac or sandarac varnish. The imprint of the tooth to be clasped then should be filled carefully with amalgam and a retaining tack inserted, as described previously. When the amalgam has crystallized, the impression should be filled with hard plaster.

When the cast has been obtained, the clasp then should be formed on the amalgam reproduction of the natural crown and to the outlines and thickness desired. The wax clasp then should be teased loose, detached carefully and replaced. The sprue-former now should be attached and the investment and casting made.

The detachment of the amalgam cast from the plaster cast is seldom necessary, but if it should be desirable, it may be accomplished easily by

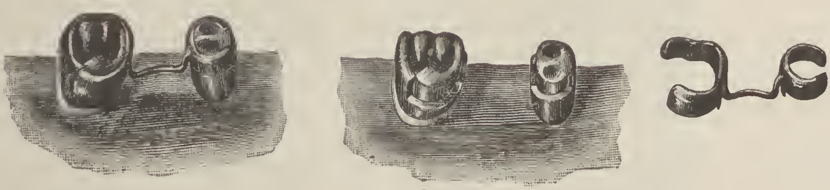


Fig. 383.

painting the amalgam and dowel with a thin coating of melted wax previous to pouring the impression. If preferable, cement may be used instead of amalgam and the cast may be made with one of the so-called artificial stone compounds, instead of plaster.

Clasps in Combination with Full Crown Restorations. The most typically ideal application of clasps as retaining agencies obtains when they may be used in combination with full crown restorations, and particularly when used in combination with full telescope crowns made in gold.

In the construction of full crown restorations which are to support clasps, whether made in gold or in combination with porcelain, no effort should be made to restore contour. Straight axial walls or surfaces should be formed and accommodation for an occlusal rest should be provided. (Fig. 382.)

When the restoration has been constructed and finished, it should be placed in position on its supporting abutment, an impression taken in plaster, and the cast obtained in plaster. The clasp then should be made by the method preferred.

In the application of clasps to full telescope crown restorations made by the casting process, a shoulder made for the purpose of affording a seat for the clasp may be provided in the construction of the restoration, and the clasp then made to fit the shoulder accurately, thus avoiding any abnormal contour, as illustrated in Fig. 383. In small fixtures of this

type the primary assemblage of the clasps with a small round clasp-metal wire, 16 to 18 gage, insures their correct relationship irrespective of the type of pontic used, or of how it may be attached to the clasps. Where a shoulder is formed in this manner, an occlusal rest is unnecessary, of course.

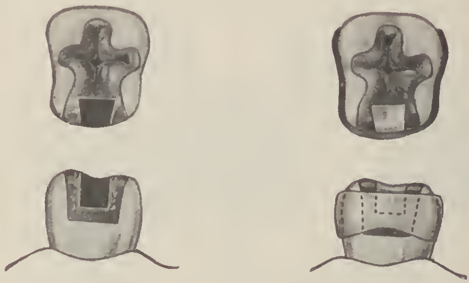


FIG. 384.

Clasps with Occlusal Rests in Inlays. Additional efficiency in the application of clasps as retaining agencies may be obtained in cases where fillings or cavities present, by making a gold inlay first and providing accommodation for the occlusal rest in the inlay. The clasp then is made with an occlusal rest which fits accurately as illustrated in Fig. 384.

Formation of Saddles.

When the clasps have been completed and finished they should be placed in position on the supporting abutments and the impression taken in plaster. When the impression has been obtained the clasps should be placed in their correct position therein and the cast then made in plaster.

Gold Saddles. If the fixture is to be constructed in gold, the design of the saddle should be traced with an indelible pencil and then outlined in the surface of the cast by scraping. The saddle then may be made either by the casting process, or by swaging, and it should be observed that contact between the saddle and clasps obtains.

In small unilateral structures, the saddle should be designed to meet the requirements of stability and the demands of restoration, as indicated previously in connection with removable bridgework.

In maxillary structures of the bilateral type the palatal portion of the connecting saddle should be of such proportions only as will insure adequate

strength in the completed structures. This part of the saddle often may be fitted in and around the rugæ in such manner as to offer but a minimum of mechanical incumbrance, as illustrated in Fig. 385.

Fig. 385.

If the casting process is used in the formation of saddles of this type, it is advantageous often and frequently necessary to make the casting in three separate pieces and unite them subsequently by soldering. In this procedure each lateral saddle should be made first and finished and then placed in position on the cast and the palatal portion then made to fit both. When each segment has been completed, all should be assembled on the cast, the relationship sustained with adhesive wax and then removed, invested, and united with solder. The same procedure is applicable also to extensive mandibular dentures.

When the saddle has been completed and finished, the clasps should be removed from the cast and placed in position on the supporting teeth and then united with the saddle by soldering.

Assemblage of Clasps and Saddle.

In dentures of any size and particularly bilateral dentures, each clasp should be attached to the saddle separately. In obtaining the correct relationship, the saddle should be placed in position and held securely by firm pressure while taking the impression.

In small unilateral saddles firm pressure may be secured with the

finger, or with gentle mandibular pressure, as described previously. In bilateral maxillary dentures mandibular pressure also may be used successfully by resting a flat piece of orangewood stick upon the occlusal surfaces of the bicuspids or molars on each side of the arch, and then so adjusting another piece as to have one end rest upon this and the other upon the center of the saddle. The impression then may be obtained successfully by using a lower impression tray.

Fig. 386.

Certainty and accuracy are insured by taking a separate impression, filling it with soldering investment compound and soldering each clasp to the saddle separately. When each clasp has been soldered successfully the denture should be placed in position and the final bite and impression taken. When the case has been mounted upon the articulator, the pontics should be selected, adapted and attached in accordance with the requirements, as indicated previously in connection with removable bridgework.

Application of Lingual Bar in Lower Dentures.

In bilateral mandibular dentures involving the replacement of the bicuspids and molars only, the assemblage of the unilateral saddles with a lingual bar affords the most ideal type of construction.

The use of a lingual bar insures adequate strength in the structure, leaves the gingival tissues surrounding the remaining natural teeth exposed freely, and offers a minimum of mechanical incumbrance.

In the construction of dentures involving the application of lingual bars, the clasps and saddles should be made first. Each clasp then should be attached to its respective saddle with solder. Saddles and clasps then should be placed in position and an impression taken in plaster. The impression should be varnished and filled with soldering investment compound and when the cast is obtained. the lingual bar should be adjusted.

While the lingual bar may be made by casting, wrought bars made in different sizes and in different grades of special alloys are procurable and are tougher and stronger. When the bar has been made, or has been selected, it should be adapted properly to the curvature and each end should rest upon and be in direct contact with the saddle.

A single layer of thin sheet wax then should be made plastic by dipping it in warm water and it should then be molded to conform closely to the surface of the cast, against which the bar has been adapted. The bar

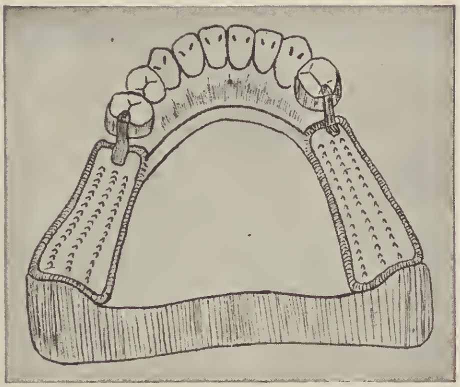


Fig. 387.

then should be placed in position against the wax and both ends sealed securely to the saddles with adhesive wax.

The thin sheet wax is used only for the purpose of holding the bar away from actual contact with the cast, and to a uniform extent at all points. This precaution is essential for the reason that close contact of the bar with the mucosa in the completed structure is not necessary and is often a source of discomfort and should be avoided.

The cast then should be submerged in water and the relationship between the bar and the saddles sustained with investment compound. When the investment has crystallized, the wax should be removed with boiling water, the cast heated and the bar and saddles assembled with solder. (Fig. 386.)

When the assemblage has been completed, the structure should be adjusted to position and the final bite and impression taken. The cast should be made in plaster (Fig. 387), and the bite adjusted and mounted upon the articulator. The pontics then should be selected and adapted and the case completed in vulcanite in the usual manner.

Use of Vulcanite.

In the construction of vulcanite dentures the clasps should be completed first, then placed in position on the supporting teeth and the final bite and impression taken. When the impression, with the clasps in position, has been obtained, it should be varnished and the inner surfaces of the clasps painted with melted wax. An ordinary pin then should be forced into the center of the imprint of each tooth clasped and the cast made in plaster:

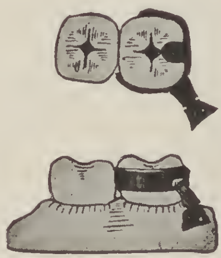


FIG. 388.

When the clasps are to be retained in their relation to the structure with vulcanite alone, each clasp should be warmed slightly over a flame and detached from the cast. The presence of the pin and of the thin coating of wax placed on the inner surface of the clasp, previous to pouring the cast, makes it possible to remove and replace the clasp with accuracy.

After detaching the clasp it should be cleaned in acid and replaced on the cast. A retaining plate made of clasp-metal, 26 gage, then should be adapted to clasp and cast in such manner as to insure strength in the attachment of the clasp with vulcanite and to offer no interference with the correct placement of the pontic immediately adjacent. (Fig. 388.) The relationship should be sustained with adhesive wax and the clasp and retaining plate then removed, invested and soldered.

Previous to replacing the clasp upon the cast, the bite should be adjusted and the case mounted upon the articulator. When separated, the clasp should be placed in position, and the case completed in the usual manner. In investing the case for vulcanite, it is necessary to observe that the clasp is protected securely with plaster, and in addition to this, the use of cement, placed over and around the clasp previous to investing, is frequently a safe precaution.

Application of Lingual Bar to Vulcanite Saddles. In the construction of clasp dentures involving the use of a lingual bar in connection with vulcanite saddles, the bite, impression, and cast, with the clasps in position, should be obtained in the manner just described. The lingual bar

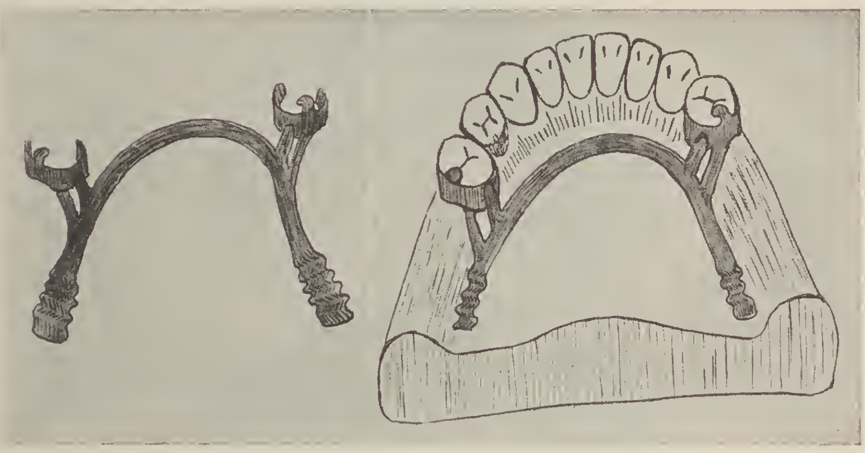


FIG. 389.

FIG. 390.

then should be made or selected and adapted as described. Each clasp then should be detached from the cast, cleaned in the acid bath and replaced. Small pieces of round, clasp-metal wire, about 16 gage, should be fitted in such manner as to afford contact with both bar and clasp. One or two wires may be used as the requirements may indicate. The relationship between the bar, clasp and wires now should be sustained securely

with adhesive wax; all should be detached from the cast carefully, invested and soldered. Each clasp should be soldered separately.

The bite should be adjusted without bar and clasps in position, and

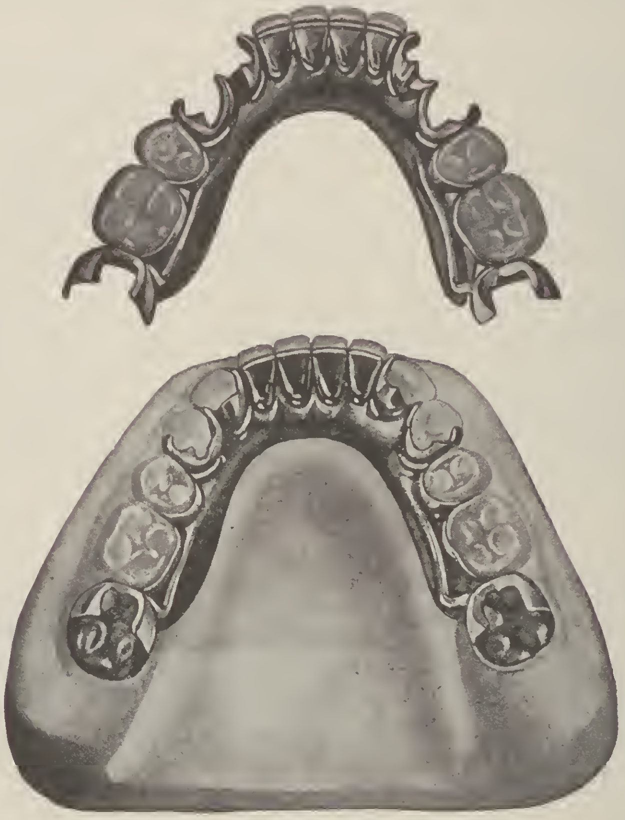


Fig. 391.

the cast mounted upon the articulator. When separated, bar and assembled clasps should be placed in position on the cast (Fig. 389), the relationship sustained securely with melted wax and the denture then completed in the usual manner. (Fig. 390.)

Mobility Attachments.

Clasps are successful retaining agencies in all cases where frictional contact and resiliency may serve as a means of retention, and yet also permit of release without any displacement of the abutment teeth. But in cases where the inclinations of the abutment teeth preclude parallelism, and particularly in cases in which an unfavorable distribution of the

abutment teeth causes the fixture to act as a lever, a rigid attachment between clasps and denture often causes the abutment teeth to assume a burden of stress beyond the limitations of comfort or of endurance.

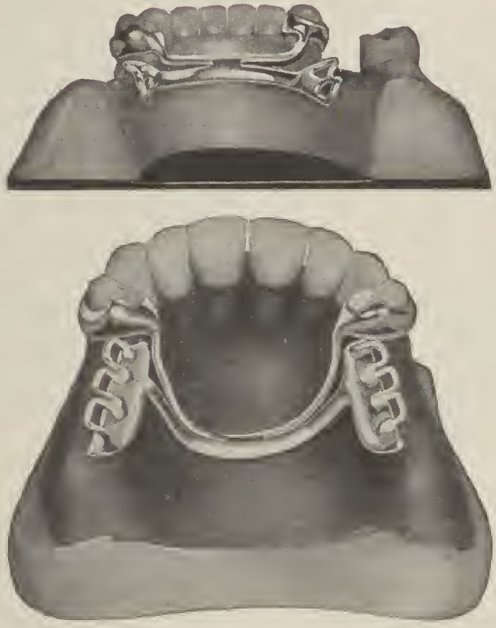


FIG. 392.

In such cases an indirect connection between the clasp and denture and a connection which retains and yet which affords some freedom of movement is essential to efficiency, comfort and permanency.

Any method of attachment which will afford an indirect or flexible, and yet secure connection between clasp and denture, therefore, is useful in many cases. Attachments of this type are designated as "stress breakers" or "stress transmitters."

Mobility attachments may consist of a simple hinge or of a length and freedom of wire which insures resiliency at the joint (Fig. 391), or any of the attachments which are manufactured for this purpose, and all have a field of usefulness when indicated.

A typical class of cases in which attachments of this type are particularly useful, and in which the denture becomes a lever and where a rigid attachment of the clasps to the structure would soon result in the loss of the supporting teeth, is illustrated in cases designed for vulcanite in Fig. 392.

The use of a resilient wire in this manner requires no special technic,

Fig. 393.

FIG. 393.

but a special technic is required in the successful application of all forms of attachments manufactured for this purpose.

Separating the Natural Crowns of Teeth.

In the application of clasps of any type it is never advisable to separate the crowns of natural teeth for the purpose of permitting the engagement of a clasp. The destruction of the contact point and the presence of a clasp passing between the natural crowns of teeth only invites failure.

Use of Ready-Made Clasps.

Ready-made clasps of various designs and in varying sizes are manufactured; but since accuracy of design and of adaptation are essential to the successful application and to the efficiency of clasps as retaining agencies, and since these features are not easily obtained even when the clasp is made for the individual case and of a known alloy, it is not reasonable to expect a ready-made form to meet the high requirements.

Furthermore, no knowledge of the composition of the alloy of which they are made or of its heat-withstanding and resilient properties eliminates certainty and reliability in their use.

Summary.

Whenever the indications are favorable, and whenever all of the requirements in the composite are met carefully, clasps are the simplest and most universally applicable type of retaining agents, and the clasp denture is the most generally useful type of removable structure.

Perhaps the most objectionable feature incident to the application of clasp dentures is the frequent development of a hypersensitiveness of the tooth structure immediately beneath the clasps in teeth having vital pulps.

This condition is undoubtedly caused by an induced erosion, and it is noticeable that it presents more frequently when cast clasps are used than when wide wrought clasps are used. This would indicate that close-fitting clasps are more injurious to tooth structure than are those which fit less accurately.

Aside from the development of this hypersensitiveness of tooth structure, other injurious effects which may result are largely a question of sanitation on the part of the patient. Hence, patients wearing clasp dentures must be advised of the necessity for scrupulous sanitation and careful hygiene at all times.

The typical application of clasp dentures to a variety of cases is illustrated in Fig. 393.

Final Considerations.

CHAPTER XIX.

INSERTION OF GOLD FILLINGS IN PORCELAIN TEETH AND FACINGS.

Gold fillings are indicated very often in porcelain teeth, or facings used in the construction of crowns or of bridgework, in order to simulate more closely the remaining natural teeth and thus to comply with the requirements of harmony, as has been referred to previously.

Indications. In the restoration of the crowns of any of the anterior teeth, where the remaining adjacent natural teeth are filled with gold more or less freely, the restoration may and often should carry one, or perhaps two small approximal fillings.

In bridgework involving the upper anterior teeth, where the lower anterior teeth are filled freely with gold, the insertion of one or two small fillings in desirable locations often will aid materially in detracting from the artificial appearance of the denture.

Such fillings, however, never should be inserted with a view to making the work conspicuous, nor for the exclusive purpose of additional remuneration. They should be no larger than necessary to effect the harmonious and legitimate deception which may be indicated thus by the adjacent natural teeth.

Methods. The procedure may be accomplished by any one of three different methods:

First: The preparation of a retentive cavity and filling the cavity with gold foil.

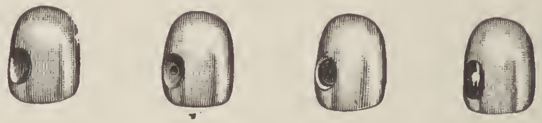
Second: The use of liquid or "Roman" gold, which is painted over the desired area, and then fired in the furnace in a manner similar to that employed in china decorating.

Third: The construction of the filling as a part of the backing.

Gold Foil. In the procedure embracing gold foil, a cavity, in the location selected and of the desired form, should be outlined first in the facing with a small, fine carborundum stone. (Fig. 394 A.) This outline facilitates the drilling of a cavity and affords a definite marginal edge

for the adaptation and finishing of the gold. When formed, adequate retention then may be secured by drilling a simple, countersunk cavity of sufficient proportions in the center of the outlined area (Fig. 394 B), or by cutting retentive grooves. (Fig. 394 C.)

For the former purpose, applicable more generally to small cavities, an inexpensive diamond drill, to be used in the engine, is obtainable.



A B C D

Fig. 394.

A B

Fig. 395.

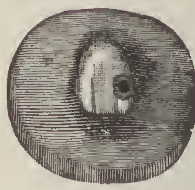


Fig. 396.

(Fig. 395 A.) Where retaining grooves which are adapted best to larger cavities are preferred, they may be cut easily with a small copper disk, coated with an abrasive, which is prepared for this and similar purposes. (Fig. 395 B.) A "cavity cutting" outfit, consisting of a set of engine instruments of oval form and graded sizes, and an abrasive compound composed of carborundum dust and glycerol, is manufactured for this purpose.

In the application of the first procedure, the free use of oil or glycerin facilitates the rapidity of the cutting and entirely eliminates the danger of fracturing the facing.

When the proper retention has been secured, the cavity should be cleaned thoroughly with soap and water and dried with alcohol and air.

It then is filled with small pellets of gold foil in the usual manner and finished. (Fig. 394 D.)

It is advisable usually to defer the insertion of such fillings until after the completion of the work, in order to avoid subsequent scratching or defacing of the surface. However, it may be necessary at times, or may seem desirable, to insert the fillings before the construction of the work or the assemblage of the parts.

This may be essential in bridgework in order to place the cavity in the desired location. When such procedure is indicated, it may be facilitated by imbedding the facing in a base of impressive compound or sealing wax, as a means of holding it securely. (Fig. 396.)

In porcelain work, the procedure necessarily must be deferred until the piece is finished in order to preclude the fusing of the gold. In any event the preparation of the cavity and the insertion of the filling should be done in immediate sequence.

Roman Gold. In the use of "Roman" gold, which is prepared for decorative purposes, and is quite applicable to this purpose, the cavity area should be outlined first, as indicated previously. (Fig. 394 A.) The gold then is mixed into a paste of proper consistency and painted thickly over the surface. Care should be taken that it follows the cavity margins closely and evenly. The facing now should be placed near a flame, or close to the previously heated furnace, and allowed to remain there until the gold has become thoroughly dry. Then it should be placed in the furnace and "fired" until the gold fuses. This may be known readily by its vitreous appearance.

Allowing the case to cool more or less slowly, the filling then may be finished and polished with burnishers, or fine cuttlefish disks and the buff wheel.

In gold work, fillings should be made *before* the final attachment of the facing to the metal parts. In porcelain work the lower heat required to fuse gold demands that they be made *after* the completion of the case.

While this method affords artistic possibilities, the results are likely to be less permanent, because of a tendency to flake and chip.

In Combination with Backing. A method involving less simple detail, requiring more time perhaps but productive of very artistic results, is also applicable. It consists of making the filling in combination with and as a part of the gold backing.

This procedure is indicated particularly in simulating mesial and distal fillings involving the incisal angle. Because of the limited opportunity afforded by the ordinary facing for securing adequate anchorage for such

fillings, this procedure would often be more difficult by other methods.

When such a filling is indicated, or where it may be desirable to use this method, a flat-back facing should be ground to the proper and required adaptation first, and then prepared for the reception of the backing in the usual manner.

That portion of the porcelain facing which involves the location and area of the desired gold restoration then should be ground away on a

A B C D E

Fig. 397.

slight bevel toward the lingual side until a perfectly smooth marginal outline obtains. (Fig. 397 A.)

A backing of pure gold, 36 gage, now should be adapted to the facing, and burnished close against the cavity margin, allowing a surplus of about 1-2 millimeter to project beyond the latter, and upon the incisal end. (Fig. 397 B.) When this has been accomplished, a piece of 22 karat gold plate, 29 gage or 30 gage, should be adapted to the pure gold backing extending from the pins to the incisal end, and projecting to the original outline of that portion of the facing which has been sacrificed. (Fig. 397 C.)

This forms a matrix, outlining the desired formation of the filling, and the two backings now should be removed and united with solder in the manner previously described in connection with reenforced backings.

Their detachment from the facing, without danger of changing the shape of the thin, pure gold backing, is made possible and facilitated by the slight lingual bevel given the cavity walls.

When their union has been effected, the matrix formed by the two backings should be filled with 22 karat solder until the desired contour is obtained. (Fig. 397 D.)

The completed backing then should be adjusted to the facing and finished with stones and disks until the adaptation of the backing and the contour of the filling are as desired (Fig. 397 E), when the case may be completed and finished in the usual manner.

In obtaining the desired contour of the filling with solder, a high karat must be used because of the susceptibility of solder to discoloration, and care should be exercised to avoid a pitted surface.

In filling the matrix with solder, the precaution of fitting a piece of gold wire or plate into it before the procedure will insure a preservation of the adaptation of the pure gold backing to the marginal outlines of the cavity. The adaptation might be changed somewhat by shrinkage if solder alone were used.

CHAPTER XX.

REMOVING AND REPAIRING.

As a result of wear, of accident, or of failure to subscribe to the highest possibilities in some or in all of the requirements, or because of the development of caries, or of more serious pathological conditions involving the root-ends of supporting teeth, the removal and repair of restorations of all types is often necessary. And whenever necessary, operations of this character should be executed with the same deftness and skill which should be evidenced in the original construction and oftentimes with even greater expediency.

Removing Full Telescope Crown Restorations.

While it might be possible in many instances to drill through the occlusal surface of full telescope crown restorations, and by making a generous opening, to treat and fill pulp canals successfully, and subsequently to restore this surface of the restoration with an inlay; or, while it might also be possible to treat caries successfully, or to correct the evils of faulty adaptation in a similar manner, still the immediate removal of the restoration will facilitate, to a great extent, an observation of any therapeutic or mechanical requirements, and is always the best method of procedure.

In the removal of full telescope crown restorations, two methods are followed. In one the continuity of the telescoping portion of the restoration is preserved. In the other it is destroyed.

Preserving Continuity of Band. Whenever it may be desirable to remove the restoration in such manner as to preserve the continuity of the telescoping band and thereby permit the repair and replacement of the same restoration, the procedure may be effected in a simple manner by drilling a small hole through the band at some convenient point immediately beneath the occlusal surface with a spear drill or round bur, as illustrated in Fig. 398.

When the hole has been drilled entirely through the band, a round or fissure bur then should be carried laterally, or mesio-distally, until

the layer of cement between the occlusal surface of the restoration and the end of the supporting root has been removed or its integrity destroyed.

A small pointed instrument, not highly tempered, then should be introduced into the hole until its end rests firmly upon the supporting root at a point relatively near the center. With a fulcrum thus established the power of the lever may be used and the restoration easily detached and removed.

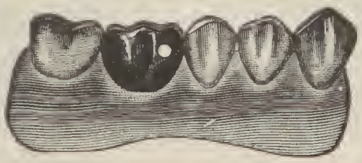


FIG. 398.

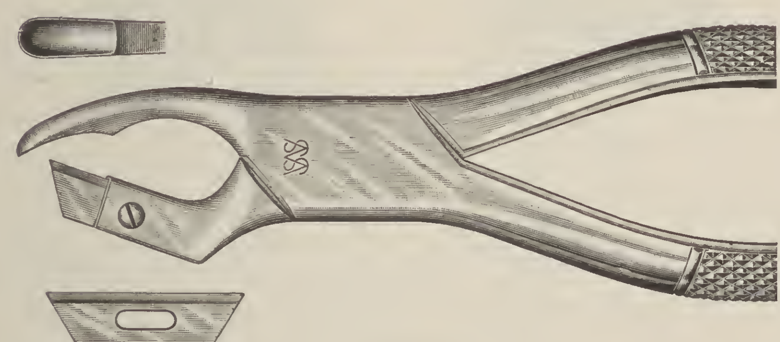


FIG. 399.

Destroying Continuity of Band. Whenever this procedure is not successful immediately, or where the replacement of the same restoration is not desirable or necessary, removal may be effected in the simplest manner by destroying the continuity of the band. Special forceps designated as "crown-slitting forceps" are made for this purpose. (Fig. 399.) In their use the flat beak is placed firmly upon the occlusal surface of the restoration and the cutting beak carried beneath the gingival edge of the band. Slight compression upon the handles will destroy the continuity of the band and lift the restoration off easily.

Removing Dowel-Crown Restorations.

The removal of dowel-crown restorations is more difficult usually, and more dangerous always. Great care must be exercised to avoid fracturing the supporting root.

Whenever applicable, the easiest and simplest method of removing dowel-crown restorations would be by the use of excising forceps.

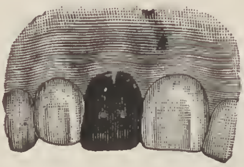


Fig. 400.

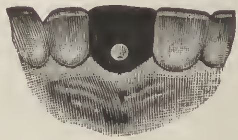


Fig. 401.

Fig. 402.

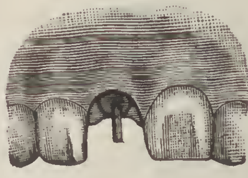


Fig. 403.

In the use of excising forceps, the facing should be broken away first and the coping then grasped firmly, and carefully twisted or rotated.

The power of the lever exerted carefully will result usually in destroying the integrity of the cement, permitting detachment without injury to the supporting root and without mutilation of the coping.

If detachment is not obtained easily, it may be facilitated by destroying the continuity of the coping at some favorable point, as illustrated in Fig. 400. This usually may be accomplished easily by the use of a small round or fissure bur.

Where detachment is not to be accomplished easily, however, it may become necessary to separate the coping from the dowel. This procedure involves drilling through the lingual surface of the coping at a point which will destroy the attachment between dowel and coping, leaving the dowel in the root, but permitting the removal of the coping. (Fig. 401.) The dowel then may be removed subsequently.

Another method consists in destroying a large portion of the coping

with round and fissure burs as illustrated in Fig. 402, but allowing enough to remain to facilitate the subsequent removal of the dowel. (Fig. 403.)

The dowel then may be removed by means of a dowel removing instrument designed for the purpose (Fig. 404), or by drilling it out with small round burs. In the use of burs, the smallest size round burs should be used, and in their use they should be passed around the periphery

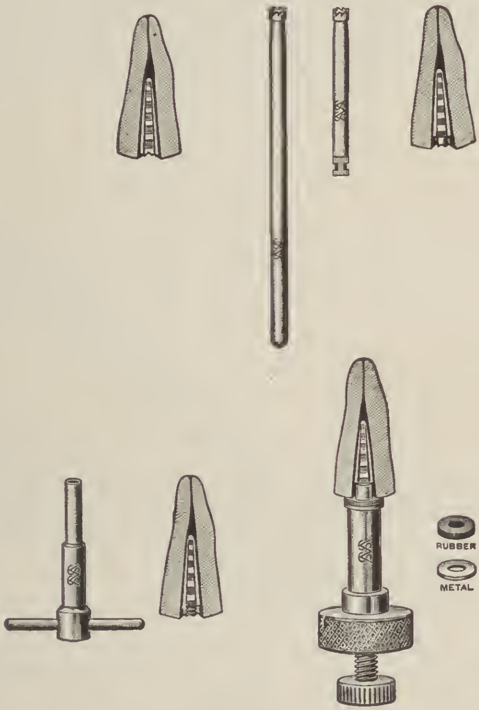


Fig. 404.

of the dowel, but at the expense of the dowel and not at the expense of the supporting root. The diameter of the dowel should be reduced without appreciably increasing the diameter of the canal, and care must be exercised at all times to avoid perforating or unnecessarily weakening the root.

In the use of the dowel-removing instrument the diameter of the exposed end of the dowel is reduced first, using a small trephine. The reduced end is then threaded with the tap. The socket of the instrument is now screwed securely to the threaded end of the dowel, and its removal affected by turning the large knurled head.

Removing Inlays.

In the removal of inlays which have been used as abutment attachments, great care must be exercised to avoid fracturing the supporting natural crown. This precaution, combined with easy removal, usually may be accomplished effectually by drilling a hole into the body of the inlay at an angle which will accommodate and engage the end of a strong, blunt-pointed instrument and permit the use of the instrument as a lever. If a hole is made at the proper angle, the inlay usually may be detached and lifted out easily. (Fig. 405.)

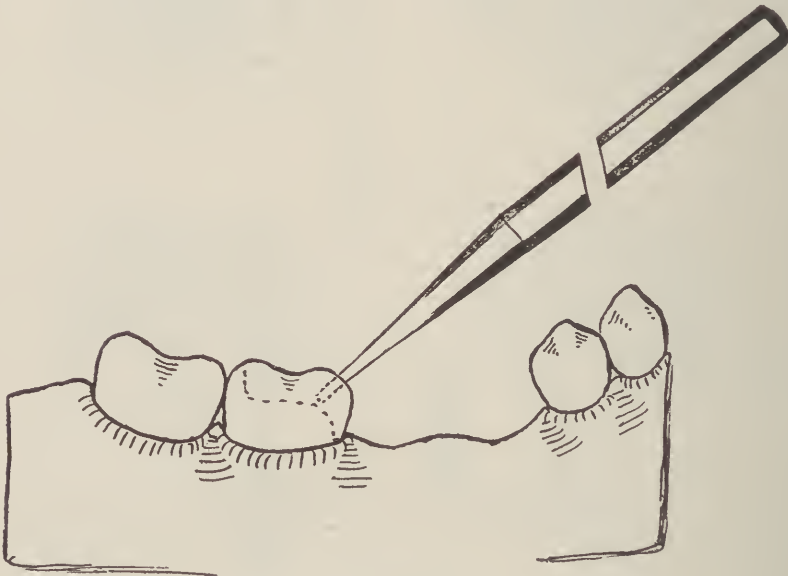


Fig. 405.

Removing All-Porcelain Crown Restorations.

The removal of all-porcelain crown restorations of any type usually is a very simple procedure. When the restoration is of the dowel type, the insertion of the beaks of excising forceps into the immediate joint between the restoration and the supporting root, followed by the application of pressure upon the handles, will wedge the restoration from its attachment easily. The dowel then may be removed as indicated.

The removal of all-porcelain jacket crowns may be effected in the best, quickest and easiest manner by cutting a deep groove in the center of the labial or buccal surface, extending from the gingival edge to the

incisal or occlusal angle, and then destroying the continuity by the insertion of a wedge-pointed instrument into the groove.

Removing Fixed Bridgework.

The removal of fixed bridgework usually is attended with discomfort and effected with difficulty. When the replacement of the same fixture is desirable, fixed structures often may be removed successfully and without mutilation of attachment or pontics by the use of a percussion hammer designed and made for this purpose. (Fig. 406.)

In the use of this instrument an effort should be made to hook over, or grasp each attachment separately and then to loosen each attachment by the continued application of moderately heavy blows with the cylindrical weight as a percussion hammer. Detachment and removal will follow unless the fixation is so secure as to demand the mutilation or partial mutilation of the attachments.

In this event, the procedures indicated previously for each of the various types of attachments may become necessary; but whenever the replacement of the same fixture is not to be made, detachment and removal should be effected in the easiest and simplest manner.

Repairing.

When the removal of fixtures which are to be repaired and replaced has been effected, the piece then should be boiled in dilute hydrochloric acid and washed thoroughly in a solution of sodium bicarbonate. Repair then should be made in accordance with the requirements of the case, and of investing and soldering as indicated previously.

In repairing either single crown restorations or fixtures of any size in which replaceable facings or teeth have been used, and where the case must be invested and soldered after the pontics have been attached with cement, when repair has been effected, all of the pontics must be removed and replaced with a new mix of cement. Where it may seem desirable, the facings on teeth may be removed before subjecting the fixtures to the heat of soldering.

FIG. 406.

Removal and replacement of all pontics so attached become necessary at all times and in all cases for the reason that the heat required in soldering disintegrates the cement to such an extent as to result in a very insecure attachment, and an attachment which would not withstand chemical action of the oral secretions for any length of time, however perfectly the backings may be adapted.

Therefore, when repair has been effected by soldering, the case should be boiled in the acid bath until all facings or teeth may be detached, after which they should be recemented.

Repairing Without Removing.

The replacement of porcelain pontics of all types is demanded frequently and constitutes a very large percentage of all repairing which may be accomplished without removing the restoration.

Replacing Cemented Pontics.

When any of the various types of interchangeable or replaceable facings or teeth have been used in the construction, replacement is simple. In the procedure, all remaining particles of porcelain and cement which may cling to the backing should be removed with a sharp chisel or bur, and the substitute then selected, ground to meet the requirements of adaptation, and cemented to place.

Sample molds are useful in making the selection of substitutes, but in their absence a small impression should be taken in pink base-plate wax and a cast made and used for this purpose.

Replacing Pin Facings.

The replacement of pin facings which have been soldered to the basic structure is much more difficult, which constitutes another reason for not using facings of this type.

When pin facings are to be replaced, however, several different methods of procedure may be followed.

The simplest and most generally useful method, which is applicable either to single crown restorations or to bridgework, consists first in removing the remaining pins even with the surface of the backing and then drilling holes through the backing, cementing and clinching a new facing by bending the pins over upon the backing.

In this simple procedure the projecting pins are removed with a small bur and a suitable facing selected. The backing now is covered with a thin coating of melted wax into which the ends of the pins of the new facing are imprinted. Holes of the same diameter as the pins then are drilled entirely through the backings at the points indicated.

Accommodation for the pins being afforded thus, the facing then is ground to the proper adaptation. The ends of the pins should extend entirely through the backing and to an extent which will permit bending them over upon the lingual surface of the backing after cementation. If the backing is too heavy to leave the ends of the pins exposed to the desired extent, it should be made thinner previously by grinding.

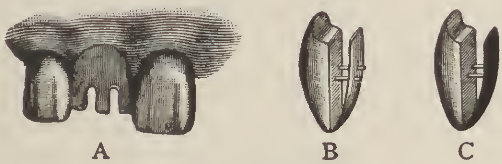


FIG. 407.

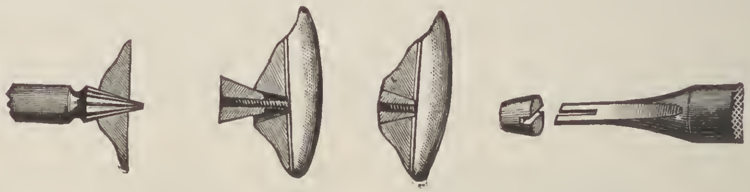
When the adjustment is completed, the facing then should be mounted with cement and the surplus ends of the pins bent with suitable pliers in such manner as to be clinched against the backing. After the cement has crystallized, the pins then should be flattened, using small stones and disks, and then finished and polished smooth.

Another method, which also is applicable either to single crown restorations or to bridgework, and which is particularly useful in cases where the incisal end of the backing is not heavy or overstrong, consists in cutting grooves for the accommodation of the pins in the incisal edge of the backing, as illustrated in Fig. 407 A. The exact points at which the grooves should be placed may be indicated by means of a thin coating of melted wax, as suggested previously.

When the grooves have been cut to the depth required, a backing of pure gold, about 36 gage, then should be perforated to accommodate the pins. (Fig. 407 B.) The facing then should be adjusted to position and the backing adapted closely to the basic structure by burnishing. When burnished, the relationship should be sustained with base-plate or adhesive wax and facing and backing then removed, invested, and attached by soldering. All of the reenforcement which the occlusion will permit should be made at the same time. When thus attached and reenforced (Fig. 407 C) facing and backing then are cemented to place.

Use of Bryant Repair Outfit.

Another more complicated method of replacing pin facings involves the use of what is known commercially as the Bryant repair outfit. In the use of this method of procedure, a cone-shaped hole for the reception of each pin is drilled through the backing from the lingual surface, using a standard cutting bur for the purpose. (Fig. 408 A.) When the holes



A B C D

Fig. 408.

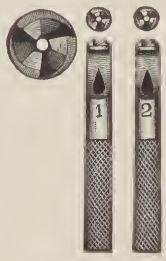


Fig. 409.

are drilled for each pin, the facing then is adjusted to the proper adaptation by grinding, after which the pins are threaded with a tap which is a part of the outfit. (Fig. 409.) The facing then is placed in position and a cone-shaped nut supplied especially for this work is adjusted to the threaded pin and screwed to place until the facing is retained firmly. (Fig. 408 B.) Any and all surplus subsequently is finished smooth and flush with the contour of the supporting basic structure. (Fig. 408 C.) The adjustment of the nut is accomplished with facility by means of a special wrench. (Fig. 408 D.)

Cast Gold Pontics.

In the replacement of posterior pontics, cast gold pontics often may be fitted to the basic structure and used to better advantage than would be afforded by replacement with porcelain.

In the replacement of porcelain pontics with cast gold pontics, casting wax should be made plastic and molded to fit the basic structure and to meet all of the requirements of occlusion and of contour in the usual manner. The pattern then should be invested and the casting made, finished and cemented in the same manner as indicated for inlays.

Use of Silicate Cements.

In the replacement of pin facings, where the pins remain, the use of silicate cements often may afford successful results.

Repairing Porcelain Bridgework.

The repair of porcelain bridgework usually is a difficult and somewhat hazardous procedure. The removal must be made in accordance with the requirements of the case and along the lines suggested.

When the fixture has been removed, it should be cleaned thoroughly first with soap and water. Then it should be boiled in dilute hydrochloric acid and afterward immersed in a tepid solution of sodium bicarbonate. Any remaining organic matter then must be removed before repair is attempted. The removal of organic matter may be accomplished successfully only by the application of heat.

In this procedure the piece should be placed in the furnace while the muffle is just warm, and the temperature then increased gradually until a red heat obtains and all organic matter is burned out. It then should be allowed to cool slowly. Any additions of new porcelain made necessary by the requirements of repair then may be made and fused successfully, as described previously.

In large restorations any danger of fracture, or of injury to the fixture which may be caused by too rapid heating or cooling, in burning out organic matter may be overcome entirely by previously investing the case, using an investment compound composed largely of asbestos.

CHAPTER XXI.

FINISHING AND POLISHING.

The wonderful luster and smoothness of surface obtainable by finishing and polishing gold and platinum and their alloys attracts the admiration of all and particularly of those who manipulate them.

In all lines of purely artistic endeavor in which gold and platinum are used, finishing and polishing are a means of enhancing beauty. But in dental restorations of any type, finishing and polishing constitute an important part of construction and, irrespective of the skill displayed otherwise, unless a fine finish is obtained, the final product is not a work of art, nor does it subscribe to the highest possibilities from the viewpoint of hygiene and sanitation.

A definition of finishing and polishing might be given as a succession of scratches all running in the same direction and growing finer and finer. And in proportion as the scratches grow finer, the surface becomes smoother and the luster more accentuated; and in proportion as smoothness and luster increase, hygiene and sanitation are rendered more possible.

Therefore, since both art and sanitation are thus obtained, restorations of any size and of all types must be finished properly and polished highly, irrespective of the time required.

Finishing. When the piece has been treated to the acid bath and all traces of acid removed by immersing in a solution of sodium bicarbonate, then it should be finished.

The preliminary finishing may be accomplished in the simplest and most expedient manner by means of stones and disks used in the engine.

Beginning with carborundum and vulco-carborundum stones of medium coarseness and suitable size, all sharp edges and angles should be removed, inaccessible pockets and solder pits obliterated, and all surfaces worked down until proper contour and definite finishing lines obtain.

All grooves and sulci in the occlusal surfaces of telescope crowns should be made smooth and well defined, and where facings of any type have been used in the construction of anterior dowel-crown restorations, the natural shape and form of the lingual surface should be reproduced

in the backing, as illustrated in Fig. 410. This may be accomplished easily with small knife-edge stones and round burs.

Coarse, then medium, and finally fine disks should be used until all deep scratches are removed, and until the desired contour and smoothness of surfaces obtain.

Polishing. This procedure then should be followed by polishing with felt and brush wheels on the lathe. The primary polishing may be secured

Fig. 410.

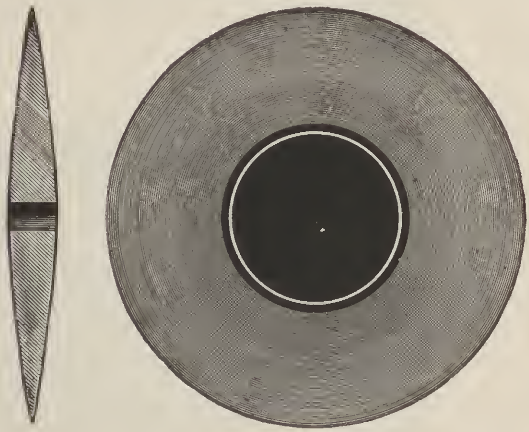


Fig. 411.

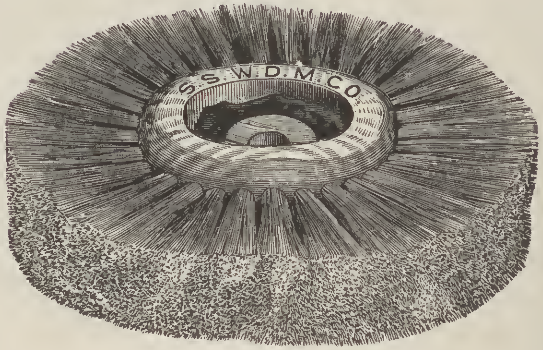
in the best manner by the use of a thin-edge felt wheel (Fig. 411) and a moistened abrasive powder or compound, and the felt wheel should be soaked previously in water in order that it may absorb and carry the abrasive during the procedure.

When the desired smoothness of surface has been obtained thus, the final polishing should be given, first using a stiff brush-wheel (Fig. 412 A) with the abrasive, and then using a polishing compound, such as tripoli, or whiting, or precipitated chalk. This procedure should be followed with a soft brush-wheel (Fig. 412 B) and finally with a "buff" wheel (Fig. 412 C) until a highly polished surface is obtained.

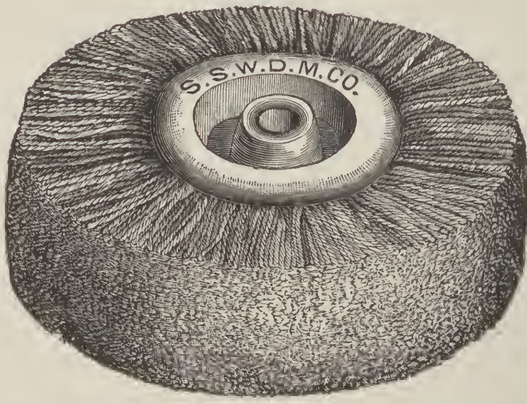
The more highly all surfaces of metal are polished, the less susceptible they are to discoloration, and the more permanent will be the polish.

Fine silex and pumice stone, mixed into a thick paste, are used as an abrasive, and tripoli, jewelers' rouge and various other polishing compounds are used with whiting, or precipitated chalk, with the "buff" wheel for a final polishing.

A



B



C

FIG. 412.

Facilitating Procedure. As full telescope crown restorations are somewhat difficult to handle while polishing, various styles of "crown-holders" have been devised for facilitating this procedure. (Fig. 413.)

Filling the restoration with impression compound, or with sealing wax, and then inserting a piece of wood into it while still plastic, is recommended also, but this procedure is objectionable because of the difficulty of removing the compound after the polishing is completed.

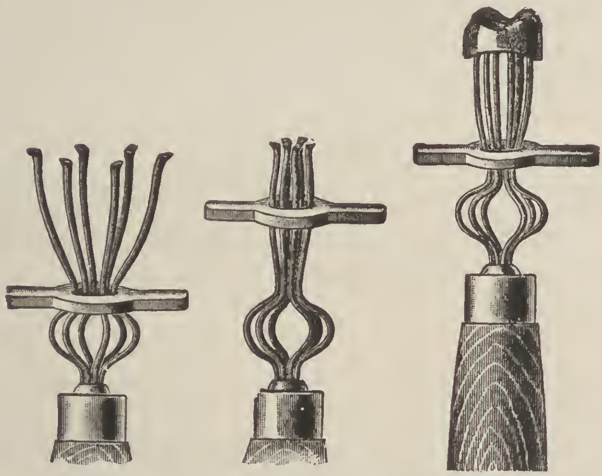


Fig. 413.

While dowel crowns are not quite so difficult to handle in polishing, the use of a jewelers' small pin vise sometimes may be found convenient.

Precautions. Although it is scarcely possible to give too high a polish to the surfaces of metal which are to be fixed permanently in the mouth, it is, however, quite possible and indeed sometimes quite easy to polish through the thinner portions of bands and saddles in the use of disks and felt wheels. Hence, extreme care should be exercised to prevent such a mishap, as well as to preclude any unnecessary thinning of such parts.

Cementing Replaceable Teeth and Facings.

When replaceable teeth or facings are used, the restoration should be finished to the point of polishing previous to the cementation of the teeth or facings; and if duplicates are to be made they should be ground to the proper and required adaptation at this time.

The original teeth or facings then should be cleaned with alcohol or chloroform, dried thoroughly, and cemented to place. When the cement has crystallized and all surplus has been removed, the final requirements in connection with polishing should be observed.

Gold Plating.

An increased artistic effect and a more attractive finish may be obtained by subjecting the piece to the electroplating process, after it has been highly polished. This imparts a uniform rich yellow color to all metal surfaces and affords a surface of pure gold which is not so easily attacked and discolored by the chemical action of the secretions.

Solutions for this purpose may be made by dissolving fifteen grains of the chlorid of gold in a porcelain or glass vessel containing about four ounces of distilled water, and then adding to this a like quantity of water into which about thirty or forty grains of pulverized potassium cyanid also have been dissolved previously in a similar vessel. This is known as the "cyanid solution," the approximate formula for which, as generally employed, is as follows:

Gold chlorid	gr. xv.
Potassium cyanid	gr. xxx to xl.
Distilled water	oz. viii.

A small, ordinary "primary" or "dry-cell" battery may be used and the work to be plated should be attached to the negative pole and then suspended in the solution with a piece of thin, pure gold plate, likewise suspended from the positive pole, avoiding contact between the two.

A simple plug, known as the "Teter," also may be used. In the use of this plug the current used for illumination purposes may be taken directly from the socket, resistance being obtained through the use of an eight-candle-power bulb in serial connection with the plug.

If the piece is well finished, highly polished and then washed with bicarbonate of soda to remove all traces of extraneous matter, and then fastened to the pole with small copper wire, coiling the wire so as to have a well distributed contact over the surface of the piece to be plated, a few minutes' immersion in the solution will produce the desired result, after which it should be highly polished again with the "buff" wheel. For heavy plating this procedure should be repeated two or three times.

Prepared Solutions. Solutions which may be used without a battery are prepared for this purpose and while they seem to afford good results, the deposit of gold is not so heavy and hence more temporary, and the solution can be used only until it becomes inactive.

In the use of commercially prepared solutions a sufficient quantity should be placed in a porcelain or glass vessel and heated until warm, and the work then attached to a strip of pure zinc and immersed therein.

Moderate heat and slight agitation will effect the desired result in a few moments and the effectiveness of the solution may be increased by suspending a small piece of pure gold plate on another zinc strip hooked over the edge of the vessel so that the gold is immersed.

CHAPTER XXII.

MOUNTING.

In all restorations which are to enter into a fixed relationship with the supporting abutment teeth, the permanency of the adaptation and the success of the restoration will depend entirely upon the manner in which fixation obtains.

Hence, irrespective of the ingenuity displayed in designing, or of the skill evidenced in the construction of restorations of any type or size, their final fixation to the supporting abutments is an important feature which must be observed carefully and skilfully at all times.

This procedure is termed "mounting" and the secure fixation and permanency of relationship is obtained by means of a suitable mounting medium.

Requirements of Mounting Medium.

Since much depends upon the mounting medium, any agency used for this purpose must subscribe to the following requirements:

First: It must be sufficiently plastic to be moldable in order that all intervening space may be filled completely.

Second: It must possess a fineness of texture which will permit an accurate adjustment of the relationship.

Third: It must harden or crystallize to a degree which will insure strength.

Fourth: It must be non-irritating.

Fifth: It must be reasonably impervious and insoluble.

But two agencies now in use subscribe in a general way to all of the requirements of a successful mounting medium—cement and gutta-percha.

Cement. When a maximum of permanency in fixation is desired, cement is the one dependable mounting medium, and the zinc-oxyphosphate cements are used almost exclusively. They possess all of the requirements to a favorable degree and when mixed properly, and used in the absence of moisture, a maximum of strength and permanency is insured. In order

that the maximum of efficiency may be insured, however, dental cements must be mixed to the proper consistency, must be spatulated thoroughly, and moisture must be excluded during crystallization.

In addition to an observation of these manipulative requirements, increased efficiency will be obtained by applying firm pressure and by avoiding any disturbing influence during crystallization.

The application of pressure minimizes expansion and thus increases the accuracy of adaptation in the relationship; and crystallization obtains more perfectly when any disturbing influence is avoided during the period of chemical activity.

If these features are observed, the adhesive properties of cement so strengthen and protect the supporting tooth or root as to insure a maximum of strength and of permanency in the attachment of the restoration, which, in itself, is an advantage of incalculable value.

The only feature incident to the use of cement as a mounting medium which might be regarded, in any manner, as a disadvantage, is the difficulty attached to the removal of restorations so mounted, but it is this very feature which insures permanency.

Therefore, when permanency is desired or is demanded, cement should be used, but in cases where the possible necessity for removal is anticipated, no effort toward obtaining permanency should be made, and a more temporary form of mounting should be used.

Gutta-percha. The vegetable compound known as gutta-percha is a useful mounting medium for single crown or fixed bridgework restorations whenever the possibility of removal may be anticipated, or where it may be desirable or advisable to provide for such contingency.

Gutta-percha is a tough, strong product and is prepared for dental purposes in base-plate form and in two colors, pink and white. It may be made plastic by heat if carefully applied, and is soluble in chloroform, xylol and some of the essential oils. These features make it adaptable as a mounting medium and useful in all cases where permanency is not demanded, and, therefore, where the use of cement would be contra-indicated.

When manipulated carefully and properly, even fairly permanent results may be obtained. But it is a refractory product and difficult to manipulate, and, while it is not plastic at body temperature, it is not reliable as a permanent mounting medium, for the reason that sufficient plasticity to make it moldable and adaptable requires the incorporation of a small proportion of paraffin or of one of the waxes, or the use of one of its solvents.

The incorporation of wax reduces its refractory properties, but it is this very property which insures the strength demanded of a permanent mounting medium. And the use of one of its solvents in obtaining plasticity invariably will result in shrinkage. Hence the use of gutta-

Fig. 414.

percha is indicated only in cases where a temporary medium is demanded or is desirable.

Preliminary Requirements. Previous to the final mounting of restorations of all types and of all sizes, each single unit must be adjusted to its proper position on the supporting abutment, and all of the requirements of construction observed carefully.

It is particularly essential that the occlusion should be perfected previous to mounting. Articulating paper should be used in all cases. When

all necessary adjustments have been made, the restoration should be polished again.

And, as a final procedure, the supporting abutment teeth should be disinfected and made aseptic by the free use of alcohol and hot air.

Mounting with Cement.

Since absolute immunity from moisture is essential to success and permanency when cement is to be used as the mounting medium, every precaution to exclude moisture should be taken; and since cement crystallizes more or less rapidly, thus limiting the time which may be

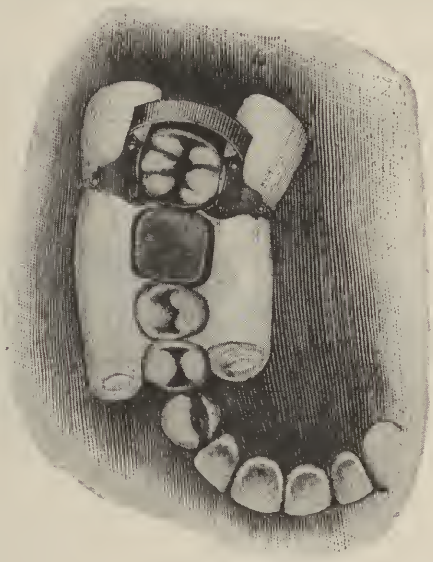


Fig. 415.

consumed in the operation, every convenience which will facilitate and expedite the procedure should be provided in advance.

The use of non-absorbent cotton rolls and of the saliva ejector should be made in all cases, and will be found immeasurably helpful at all times.

When all supporting teeth or roots are protected thus, or otherwise, they should be dried thoroughly, using alcohol and air freely. It then should be observed that the fixture itself is perfectly dry, after which the cement should be mixed properly and to the proper consistency and the mounting made.

As a further means of facilitating the procedure, the cement should be mixed by an assistant whenever possible.

In mounting anterior crowns the field of operation may be kept free

from moisture by the use of non-absorbent cotton rolls, as illustrated in Fig. 414.

Dowel Crowns. In mounting dowel crowns the canal and basal end of the root should be bathed in alcohol, using a suitable, blunt root-canal instrument with cotton, and then dried thoroughly with air. Warm air, of course, is preferable.

The cement now should be mixed properly and then pumped into the canal until it is filled completely, using a blunt, smooth root-canal plugger for the purpose. When the canal has been filled completely, the dowel and the basal surface of the coping should be covered with cement,

Fig. 416.

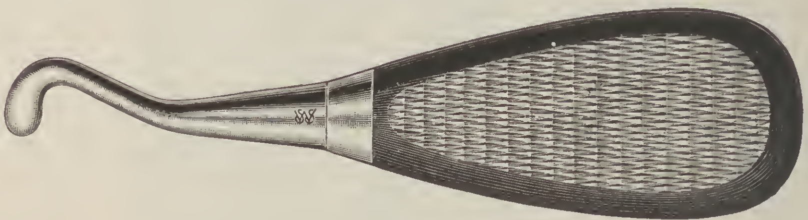


Fig. 417.

and the restoration forced to its proper position and held firmly in this relationship by pressure with the fingers until the cement has crystallized, after which all surplus should be removed.

Telescope Crowns. In mounting telescope crowns, posterior abutments may be protected from moisture by the use of cotton rolls placed buccally and lingually. These may be held in position by the fingers, or, in the lower arch, by means of a clamp, as illustrated in Fig. 415.

The same detail of procedure then should be observed, except that it is not necessary usually to apply the cement directly to the root, but a sufficient quantity should be placed inside of the crown, in which procedure it must be smeared over the surfaces in such manner as to avoid any confined air.

Full or partial crown restorations made in gold may be seated more firmly by tapping them to place, using a heavy blunt-pointed instrument (Fig. 416) and a hand-mallet for this purpose. And in full telescope

crowns in which a peripheral band is used, the adaptation of the gingival edge of the band often may be perfected immediately after the mounting by holding the crown firmly in position with the fingers and then burnishing this edge to conform closely to the periphery of the supporting abutments. A useful form of burnisher, adapted particularly to this purpose and to similar purposes, is illustrated in Fig. 417.

When the mounting has been made satisfactorily, the relationship may be sustained during crystallization by a firm closure of the teeth, or by closing firmly upon a cotton roll or small piece of soft wood and retaining the firm closure until complete crystallization obtains.

Porcelain Jacket Crowns. Greater care, of course, must be taken in mounting porcelain jacket crowns. Firm, but gentle pressure, may be applied only with the fingers, or, in posterior restorations, by closing upon a cotton roll.

In mounting porcelain jacket crowns the color of the cement used always should approximate the color of the restoration closely in order that any appreciable or undesirable change may not be caused. When some slight change is desirable, however, it may be produced by the use of a color lighter or darker, as may be indicated.

Inlay Attachments. In mounting inlay attachments it should be observed always that they are seated firmly. Moderately heavy tapping with a suitable blunt instrument is safe usually and, when safe, is always advisable as a means of insuring a maximum of accuracy in the adaptation.

Mounting Two or More Restorations. When two or more single unit restorations are to be mounted at the same sitting, and when they are to serve independently of each other, each should be mounted separately.

By mounting each single unit separately, no special speed is required, and where no effort need be made to expedite the procedure, greater accuracy probably is assured.

Fixed Bridgework. In mounting fixed bridgework where two or more attachments necessarily must be mounted simultaneously, the greatest possible care always must be exercised, first, in obtaining a free exposure of the supporting abutments; and second, in obtaining the exclusion of moisture during and immediately following the procedure.

Fixed bridgework which is adapted properly and accurately should assume its proper relationship with the supporting abutments readily, and without any appreciable binding or displacement.

And, yet, because of the varying inclinations of the abutments, or because of the unreliability of the materials and compounds used in the

construction, or both, some little effort frequently is required in the final and accurate adjustment of the relationship between the attachments and the abutments.

Any necessary adjustment of the relationship always should be made before attempting the final mounting. If great difficulty is experienced in seating the fixture, inaccuracy undoubtedly results, and, if inaccuracy obtains, it must be corrected before the final mounting.

Any appreciable binding, or any displacement of the abutments, means discomfort and invites failure, and when inaccuracy exists to this extent, warpage or distortion is the probable cause. And when warpage or distortion presents, the attachments, one or the other, or both, or all, must be separated from the pontics and again placed in position on the abutments, an impression taken and the fixture reassembled.

But if no very great binding or displacement is required, the final adjustment may be perfected and the mounting may be accomplished with greater ease and facility in many cases, and, particularly, in large fixtures, by placing the fixture in position and allowing it to remain unmounted for one, or possibly two days. Final mounting then may be effected with ease and facility. If worn for a longer period than one or two days, however, distortion and inaccuracy in the adaptation probably would follow.

When the final adjustment is perfected and is satisfactory, the attachments should be dried with alcohol and air, and the abutments then treated as indicated. The cement should now be mixed and applied to each abutment and to each attachment and the fixture then forced to place and firm pressure maintained with the fingers, or by means of soft wood or cotton rolls, until the cement has crystallized.

In mounting fixed bridgework which includes a saddle as a part of the basic structure, care must be exercised to insure the removal of all surplus cement which may be forced in between the saddle and the mucosa before crystallization is complete. If not removed before crystallization is complete, all particles which may find lodgment upon this surface of the saddle would be sources of irritation.

The retention of any surplus cement may be prevented, first, by placing a length of flattened silk tape floss, such as is used in prophylaxis, between the saddle and the mucosa, and mounting the fixture. When the mounting has been completed, and while the fixture is held with firm pressure, each end of the floss then may be grasped and drawn backward and forward over the entire surface of the saddle until the removal of all surplus is insured. Lubricating the tape floss with vaseline will facilitate the procedure.

Removable Bridgework. In mounting removable bridgework two methods of procedure are followed. The best results will be obtained by fastening the retaining attachments to the structure previously with melted base-plate wax, and then mounting the entire structure all at one time. The use of melted wax sustains the relationship of the attachments while mounting, precludes the ingress of cement into the joint between the telescoping parts, and permits of ready detachment after complete crystallization obtains.

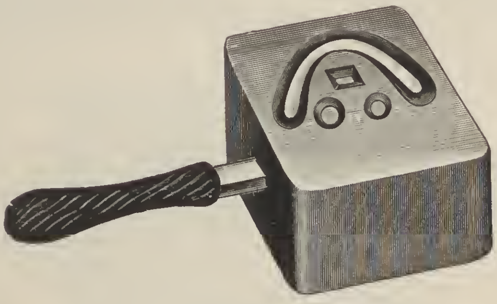


Fig. 418.

When it may not be possible or advisable to follow this method of procedure, or where some advantage may be gained from mounting the attachments to the supporting abutments separately, each attachment may be mounted independently of the structure, and the structure then forced to place while the cement is still plastic.

In either method of procedure, firm pressure should be maintained, as indicated previously, and the structure should not be disturbed until complete crystallization and secure fixation of the attachments has been insured.

Mounting with Gutta-percha.

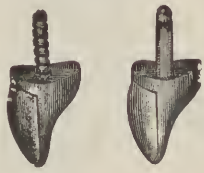
Gutta-percha as a mounting medium is applicable only to full-crown restorations of the dowel and telescope type.

Dowel Crowns. In mounting dowel crowns the gutta-percha should be cut into long, narrow strips and these strips then saturated well with oil of cajoput or eucalyptus. They then should be placed upon some form of heating iron and allowed to remain until plasticity obtains. Slow, indirect heating is essential to workable plasticity, which quality is not obtainable by the application of direct heat. A convenient form of heat-

ing iron designed for the purpose by Dr. George Evans is illustrated in Fig. 418.

When the required degree of plasticity obtains, a strip of suitable length should be coiled around the dowel, as illustrated in Fig. 419 A. The basal end and canal of the supporting root now should be moistened with tepid water and the restoration forced gently to place. This procedure should be repeated until the gutta-percha is molded to meet the requirements of close adaptation and accurate relationship. (Fig. 419 B.)

When these requirements have been met, the restoration should be placed upon the heating iron again and the supporting root then dried.



A B

Fig. 419

The surfaces of basal end of the root and of the root canal now should be moistened slightly with oil of cajeput or oil of eucalyptus, or with a moderately thick solution of gutta-percha in chloroform, and the restoration then forced to place firmly. A spray of cold water then should be directed upon the restoration until the temperature is reduced to normal, when the mounting is completed.

Telescope Crowns. In mounting full telescope crowns, the same procedure should be followed, except that the gutta-percha should be cut into pieces of convenient form and size.

Fixed Bridgework. When gutta-percha is to be used in mounting fixed bridgework, the same technic should be followed, but the adaptation to each abutment should be made separately.

Removing Restorations Mounted with Gutta-percha.

In the removal of restorations which have been mounted with gutta-percha the procedure is facilitated by the application of heat. This may be made successfully by protecting the soft tissues with cotton rolls and using a hot-air syringe, or by creating heat from friction. A leather, moose-hide, or felt polishing wheel placed in the engine and revolved rapidly, will accomplish the latter.

Combining Cement and Gutta-percha.

In mounting dowel crowns the combined advantages of cement and gutta-percha, to a limited extent, may be obtained by molding the gutta-percha to the dowel, as indicated, and then completing the mounting with cement. Increased strength in the attachment to the supporting root obtains, and removal in the event of necessity is facilitated, but the latter feature probably is obtained at the expense of permanency, and hence no great advantage follows.

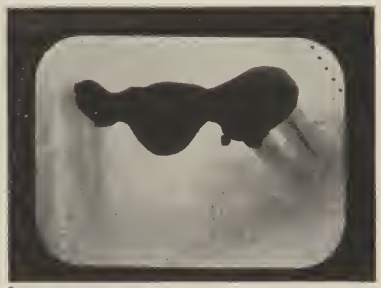


Fig. 420.

Temporary Mounting.

For all temporary purposes and in all cases where only a temporary mounting is desired or is required, the use of any of the low-heat temporary stoppings, molded and adapted, as indicated for gutta-percha, will answer the purpose nicely and affords the advantage of facility and expediency.

Precautions.

In order to guard against the possibilities of unnecessary irritation of the investing tissues in the use of cement as a mounting medium, the final precaution of carefully and thoroughly removing all surplus must be exercised always. To this end, round or flattened floss ligatures should be passed between and around the abutment teeth, and between and beneath all pontics in all cases. If this precaution is not taken, surplus in the form of nodules might remain, as illustrated in Fig. 420. These would be sources of irritation until dislodged or dissolved.

The Care of Dental Bridgework.

In the replacement of missing teeth the first duty of the dentist is to place the oral cavity in a state of health. The second is to give to the patient only such service as will promote and insure health. And the third is to teach the patient the importance of oral hygiene, and the manner in and by which sanitation may be secured, and health promoted and maintained.

Those who wear fixed bridgework should be cautioned as to the necessity for scrupulous sanitation at all times, and should be taught how to obtain it. And those for whom removable bridgework, clasp dentures and partial restorations of all types are constructed, should receive similar careful instruction.

Removable structures should be cleansed before and after each meal, whenever possible, and should always be removed over night and placed in a glass containing a mild antiseptic solution. This permits the tissues to rest and capillary circulation to become normal.

The remaining natural teeth must be kept clean, independently of the structure, and the structure itself, whether large or small, should be cleansed thoroughly, using tepid water, soap, and some form of abrasive as often as may be necessary to insure thorough asepsis.

In any line of human endeavor, proficiency, if inspired by ambition, will be acquired by application and perseverance.

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